ANNEXURE 21.4

Syllabus of the Proposed New, Unique and Distinct Programmes

DETAILED PROJECT REPORT

For Grant of Deemed to be University Status
under Distinct Category (Existing Institution)

Ramachandra-DTBU

Syllabus of the
Proposed New, Unique, Distinct (D), Industry-Integrated (I), Multidisciplinary (M) & Transdisciplinary (T) Programmes

Sl.No	School of	UG/PG/ Integrated	Name of the Program	Duration (Yrs)
1	Engineering	UG BTech	Semiconductor Technology & Chip Design	4
2		PG M Tech	Embedded Systems for Automotive & Defence Electronics	2
3		UG-PG Integrated BTech - MTech	Robotics, Automation & Intelligent Manufacturing	5
4	Applied Sciences	UG BSc	Semiconductor Devices & Nano-Electronics	3
5		UG BSc	Robotronics	3
6		UG BSc	Sustainable Technology & Climate Systems	3
7	Computing	UG BTech	Quantum Computing	4
8		UG BSc	Artificial Intelligence & Data Analytics	3
9		UG BSc	Cyber Systems & Forensic Sciences	3
10		M.Sc. (Research)	Foundation Models & Domain-Specific LLMs	2
11	Management	UG BBA (Hons.)	Entrepreneurship & Start-ups	4
12		PG MBA	Start-up Failure Analytics & Case Research	2
13		UG BCom	Digital Commerce & Financial Technologies	3
14		UG BVoc	Aquaculture Operations & Farm Management	3
15	Liberal Arts	UG BA	Psychology, Cognitive Science & Mental Health	3
16		UG BA	Fashion Designing - Digital Fashion	3
17		UG-PG Integrated	Interior Designing & Smart Systems	4
18	Indian Knowledge Systems	UG BA	Yoga & Life Sciences	3
19	Architecture	B.Arch-M.Arch Integrated	Integrated Architecture & Engineering	6

B.Tech. – SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN

Duration: 4 Years | 8 Semesters | Total Credits: 160

B.Tech. – SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN - SEMESTER I (20 CREDITS)

MATHEMATICS I (CALCULUS & LINEAR ALGEBRA)

Course Category:
Basic Science Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Mathematical foundations for engineering analysis
2. Differential calculus for optimization problems
3. Integral calculus for physical applications
4. Linear algebra for system modeling
5. Mathematical rigor for multidisciplinary engineering

Course Outcomes

CO1: Apply limits and continuity in engineering contexts
CO2: Solve optimization problems using differentiation
CO3: Use integration techniques in physical systems
CO4: Apply matrices and determinants to engineering systems
CO5: Analyze vector spaces and linear transformations

Detailed Syllabus

Unit I

Functions, limits, continuity, standard limits; differentiation principles, rules, implicit differentiation; higher order derivatives, partial derivatives; engineering rate problems, sensitivity analysis, multivariable dependence, mathematical consistency, computational interpretation, applied calculus framework.

Unit II

Applications of derivatives; maxima and minima, optimization constraints; curve tracing, asymptotes, concavity, curvature; engineering design optimization, performance tuning,

stability criteria, parametric analysis, geometric interpretation, analytical reasoning, modeling accuracy.

Unit III
Integration methods, substitution, partial fractions; definite integrals, properties; applications to area, volume, arc length; engineering work-energy relations, physical accumulation models, quantitative analysis, system evaluation, integral transforms perspective.

Unit IV
Matrices, types, algebraic operations; determinants, properties, inverse matrices; system of linear equations, rank, consistency; engineering network equations, equilibrium modeling, numerical stability, computational efficiency, structured problem solving.

Unit V
Vector spaces, subspaces, basis, dimension; eigenvalues, eigenvectors; linear transformations, diagonalization; engineering vibration analysis, state-space modeling, system decoupling, modal analysis, computational applications.

Text Books

1. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley.
2. Jain, R. K., & Iyengar, S. R. K. (2014). *Advanced Engineering Mathematics*. Narosa.
3. Erwin, K. (2018). *Advanced Engineering Mathematics*. Wiley.
4. Strang, G. (2016). *Introduction to Linear Algebra* (5th ed.). Wellesley-Cambridge Press.
5. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' Calculus* (14th ed.). Pearson.

Reference Books

1. Anton, H., Bivens, I., & Davis, S. (2016). *Calculus* (10th ed.). Wiley.
2. Boylestad, R. (2015). *Linear Algebra for Engineers*. Pearson.
3. Zill, D. G., & Cullen, M. R. (2013). *Advanced Engineering Mathematics*. Jones & Bartlett.
4. Lipschutz, S., & Lipson, M. (2017). *Linear Algebra* (Schaum's Outline). McGraw-Hill.
5. Bronson, R., & Costa, G. (2009). *Matrix Methods*. Academic Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

ENGINEERING PHYSICS (SEMICONDUCTOR PHYSICS BASICS)

Course Category:
Basic Science Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Physical principles underlying semiconductors
2. Quantum concepts for electronic materials
3. Charge transport understanding
4. Semiconductor material properties
5. Physics foundation for device engineering

Course Outcomes
CO1: Explain crystal and band structures
CO2: Apply quantum mechanics to electrons
CO3: Analyze carrier transport phenomena
CO4: Evaluate semiconductor material properties
CO5: Correlate physics concepts with device behavior

Detailed Syllabus

Unit I
Crystal structures, unit cells, lattice parameters; bonding mechanisms, covalent structures; Bravais lattices, Miller indices; crystal imperfections, point defects, dislocations; relevance to semiconductor material behavior, structural integrity.

Unit II
Quantum mechanics fundamentals; wave-particle duality, Schrödinger equation; particle in box, tunneling; density of states; quantum confinement, nanoscale effects, electronic energy distribution, physical interpretation.

Unit III
Energy bands, conductors, insulators, semiconductors; intrinsic and extrinsic semiconductors; Fermi level, carrier concentration; temperature dependence, effective mass, bandgap engineering concepts.

Unit IV
Carrier transport, drift, diffusion; mobility, conductivity; Einstein relation; continuity equation; recombination, generation mechanisms; Hall effect, measurement techniques, material characterization relevance.

Unit V
Optical properties; absorption, emission; photoconductivity; excitons; semiconductor lasers

basics; physical interaction of light with matter, optoelectronic relevance, material response parameters.

Text Books

1. Streetman, B. G., & Banerjee, S. (2016). *Solid State Electronic Devices* (7th ed.). Pearson.
2. Kittel, C. (2018). *Introduction to Solid State Physics* (8th ed.). Wiley.
3. Neamen, D. A. (2012). *Semiconductor Physics and Devices* (4th ed.). McGraw-Hill.
4. Sze, S. M., & Ng, K. K. (2006). *Physics of Semiconductor Devices* (3rd ed.). Wiley.
5. Singh, J. (2010). *Semiconductor Devices: Basic Principles*. Wiley.

Reference Books

1. Ashcroft, N. W., & Mermin, N. D. (2011). *Solid State Physics*. Brooks Cole.
2. Wolfe, C. M., Holonyak, N., & Stillman, G. E. (2012). *Physical Properties of Semiconductors*. Prentice Hall.
3. Yu, P. Y., & Cardona, M. (2010). *Fundamentals of Semiconductors*. Springer.
4. Hook, J. R., & Hall, H. E. (2010). *Solid State Physics*. Wiley.
5. Madelung, O. (2004). *Semiconductors: Data Handbook*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

ENGINEERING CHEMISTRY / ENVIRONMENTAL SCIENCE

Course Category:
Basic Science Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Chemical principles for engineering materials
2. Electrochemical process understanding
3. Environmental sustainability awareness
4. Material degradation mechanisms
5. Regulatory and ethical environmental practices

Course Outcomes

CO1: Apply chemical bonding in materials
CO2: Analyze electrochemical systems
CO3: Understand corrosion and prevention
CO4: Evaluate environmental impact of technology
CO5: Apply sustainability principles in engineering

Detailed Syllabus

Unit I

Atomic structure, periodic properties; chemical bonding, molecular interactions; hybridization, crystal field theory; relevance to engineering materials, structural stability, chemical behavior, property prediction.

Unit II

Electrochemistry fundamentals; electrode potentials, Nernst equation; electrochemical cells, batteries; fuel cells; engineering energy systems, efficiency considerations, material selection criteria.

Unit III

Corrosion mechanisms; electrochemical theory, galvanic corrosion; corrosion prevention techniques; coatings, inhibitors; material durability, lifecycle assessment, industrial relevance.

Unit IV

Water chemistry; hardness, treatment methods; desalination techniques; industrial water requirements; chemical quality control, environmental safety, sustainable resource utilization.

Unit V

Environmental science principles; ecosystems, pollution types; waste management, renewable resources; environmental regulations; sustainable engineering practices, societal responsibility.

Text Books

1. Jain, P. C., & Jain, M. (2016). *Engineering Chemistry*. Dhanpat Rai.
2. Sharma, B. K. (2014). *Engineering Chemistry*. Krishna Prakashan.
3. Dara, S. S., & Umare, S. S. (2018). *Engineering Chemistry*. S. Chand.
4. Peavy, H. S., & Rowland, T. (2014). *Environmental Engineering*. McGraw-Hill.
5. Masters, G. M. (2015). *Introduction to Environmental Engineering*. Pearson.

Reference Books

1. Bansal, S. (2015). *Environmental Studies*. Laxmi Publications.
2. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2010). *Chemistry for Environmental Engineering*. McGraw-Hill.

3. Manahan, S. E. (2017). *Environmental Chemistry*. CRC Press.
4. Raghavan, V. (2016). *Materials Chemistry*. Wiley.
5. Davis, M. L., & Cornwell, D. A. (2012). *Introduction to Environmental Engineering*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

INTRODUCTION TO PROGRAMMING (C / PYTHON)

Course Category:
Engineering Science Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Programming logic development
2. Structured problem-solving skills
3. Algorithmic thinking foundation
4. Computational implementation skills
5. Preparation for advanced programming courses

Course Outcomes
CO1: Develop basic algorithms
CO2: Implement programs using control structures
CO3: Use arrays and functions effectively
CO4: Apply programming to engineering problems
CO5: Debug and optimize basic programs

Detailed Syllabus

Unit I
Programming fundamentals; problem definition, algorithms, flowcharts; data types, variables; input-output operations; program structure, compilation process, computational logic, syntax discipline.

Unit II
Operators, expressions; decision making, conditional statements; looping constructs; iteration control; logical flow management, efficiency considerations, structured execution patterns.

Unit III
Arrays, strings; memory representation; basic operations; sorting, searching concepts; data organization, computational accuracy, problem decomposition.

Unit IV
Functions, parameter passing; recursion basics; modular programming; scope, lifetime; code reusability, abstraction, structured development practices.

Unit V
Introduction to Python or C libraries; file handling basics; simple applications; error handling; programming applications in engineering analysis, automation relevance.

Text Books

1. Kernighan, B. W., & Ritchie, D. M. (2015). *The C Programming Language*. Pearson.
2. Reema Thareja. (2019). *Programming in C*. Oxford University Press.
3. Downey, A. B. (2015). *Think Python*. O'Reilly.
4. Deitel, P., & Deitel, H. (2016). *C How to Program*. Pearson.
5. Lutz, M. (2013). *Learning Python*. O'Reilly.

Reference Books

1. Kanetkar, Y. (2017). *Let Us C*. BPB.
2. Zelle, J. (2016). *Python Programming*. Franklin Beedle.
3. Horowitz, E., & Sahni, S. (2008). *Fundamentals of Programming*. Galgotia.
4. Turing, A. (2010). *Computational Thinking*. Springer.
5. McGrath, M. (2017). *Python in Easy Steps*. In Easy Steps.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING

Course Category:
Engineering Science Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Electrical fundamentals understanding
2. Circuit analysis competence

3. Electronic component familiarity
4. Practical engineering relevance
5. Foundation for advanced electronics

Course Outcomes

CO1: Analyze basic electrical circuits
CO2: Apply network theorems
CO3: Understand electrical machines basics
CO4: Identify electronic components
CO5: Relate fundamentals to real systems

Detailed Syllabus

Unit I

Electrical quantities, Ohm's law; DC circuits, Kirchhoff laws; power, energy; series-parallel networks; engineering measurement relevance, analytical consistency.

Unit II

AC fundamentals; sinusoidal waveforms; RMS values; phasors; impedance; power factor; resonance concepts, frequency response, system behavior.

Unit III

Network theorems; Superposition, Thevenin, Norton; maximum power transfer; circuit simplification, analytical efficiency, design applications.

Unit IV

Electrical machines basics; transformers principles; DC machines overview; efficiency, losses; industrial relevance, operational understanding.

Unit V

Electronic components; diodes, transistors, applications; rectifiers; amplifiers basics; electronic system building blocks, functional relevance.

Text Books

1. Hughes, E. (2016). *Electrical and Electronic Technology*. Pearson.
2. Theraja, B. L., & Theraja, A. K. (2018). *Electrical Technology*. S. Chand.
3. Boylestad, R. (2015). *Introductory Circuit Analysis*. Pearson.
4. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2013). *Electric Machinery*. McGraw-Hill.
5. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic Circuits*. Oxford.

Reference Books

1. Alexander, C. K., & Sadiku, M. N. O. (2017). *Fundamentals of Electric Circuits*. McGraw-Hill.

2. Hambley, A. R. (2018). *Electrical Engineering Principles*. Pearson.
3. Horowitz, P., & Hill, W. (2015). *The Art of Electronics*. Cambridge.
4. Nahvi, M., & Edminister, J. (2013). *Electric Circuits*. McGraw-Hill.
5. Wildi, T. (2014). *Electrical Machines, Drives, and Power Systems*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

COMMUNICATION SKILLS & PROFESSIONAL ENGLISH

Course Category:
Humanities & Management Course

Credits / Contact Hours:
2 Credits / 30 Contact Hours

Course Objectives

1. Professional communication competence
2. Technical writing skills
3. Oral presentation ability
4. Workplace interaction skills
5. Ethical and professional language usage

Course Outcomes
CO1: Communicate effectively in professional contexts
CO2: Prepare technical documents
CO3: Deliver structured presentations
CO4: Participate in professional discussions
CO5: Apply ethical communication standards

Detailed Syllabus

Unit I
Communication process, barriers; verbal, nonverbal communication; listening skills; professional etiquette; interpersonal effectiveness, workplace relevance.

Unit II
Technical vocabulary; sentence structures; grammar essentials; clarity, coherence; professional correspondence fundamentals.

Unit III
Technical writing; reports, emails, proposals; organization, formatting; documentation standards; professional presentation norms.

Unit IV
Oral communication; presentations, interviews; group discussions; confidence building; articulation, audience awareness.

Unit V
Ethics in communication; cross-cultural aspects; workplace scenarios; conflict resolution; professional responsibility, corporate communication.

Text Books

1. Raman, M., & Sharma, S. (2017). *Technical Communication*. Oxford.
2. Bovee, C. L., & Thill, J. V. (2015). *Business Communication Today*. Pearson.
3. Murphy, R. (2016). *English Grammar in Use*. Cambridge.
4. Guffey, M. E. (2014). *Business Communication*. Cengage.
5. Lesikar, R. V. (2011). *Business Communication*. McGraw-Hill.

Reference Books

1. Alred, G. J., Brusaw, C. T., & Oliu, W. E. (2012). *Handbook of Technical Communication*. Bedford.
2. Lucas, S. E. (2015). *The Art of Public Speaking*. McGraw-Hill.
3. Comfort, J. (2018). *Effective Presentations*. Oxford.
4. Mohan, K., & Banerji, M. (2016). *Developing Communication Skills*. McMillan.
5. Chaney, L. H., & Martin, J. S. (2014). *Intercultural Business Communication*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

ENGINEERING GRAPHICS / WORKSHOP PRACTICE

Course Category:
Engineering Science Course

Credits / Contact Hours:
1 Credit / 15 Contact Hours

Course Objectives

1. Engineering drawing proficiency
2. Visualization skills development
3. Workshop tool familiarity

4. Safety awareness
5. Practical engineering skills foundation

Course Outcomes
CO1: Prepare basic engineering drawings
CO2: Interpret orthographic projections
CO3: Visualize three-dimensional objects
CO4: Use basic workshop tools safely
CO5: Apply standards in engineering practice

List of Experiments / Exercises

1. Practice of drawing instruments usage, line types, lettering standards, and basic geometric constructions following BIS conventions.
2. Construction of orthographic projections of points and lines using first-angle projection and accurate dimensioning methods.
3. Projection of planes with varying orientations, true shape determination, and spatial visualization techniques.
4. Projection of simple solids, axis orientation analysis, and interpretation of engineering components.
5. Development of isometric projections from orthographic views with proportional accuracy and visualization skills.
6. Freehand sketching of basic machine components focusing on proportion, clarity, and representation.
7. Introduction to workshop tools, identification, handling methods, and safety practices.
8. Basic fitting operations demonstration including measurement, marking, and material handling.
9. Observation of simple machining processes with emphasis on operational understanding and safety.
10. Engineering drawing interpretation exercises linking drawings with physical components.

Expected Outcomes
Enhanced visualization ability, drawing accuracy, practical tool awareness, safety compliance, and foundational engineering practice skills.

Evaluation Scheme
Continuous Assessment (100%)

II SEMESTER — B.Tech. Semiconductor Technology & Chip Design (20 CREDITS)

MATHEMATICS II (PROBABILITY & STATISTICS)

Course Category:
Basic Science Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Probabilistic reasoning for engineering uncertainty
2. Statistical methods for data analysis
3. Random variable modeling
4. Probability distributions for engineering systems
5. Statistical inference for decision making

Course Outcomes
CO1: Apply probability axioms and theorems
CO2: Analyze discrete and continuous random variables
CO3: Use probability distributions in engineering problems
CO4: Apply sampling and estimation techniques
CO5: Perform hypothesis testing and regression analysis

Detailed Syllabus

Unit I
Probability fundamentals, sample space, events; axioms, addition and multiplication theorems; conditional probability, Bayes theorem; engineering uncertainty modeling, reliability estimation, risk assessment, analytical consistency.

Unit II
Random variables, discrete and continuous types; probability mass and density functions; cumulative distribution functions; expectation, variance, moments; engineering signal variation analysis, statistical characterization.

Unit III
Discrete distributions, binomial, Poisson, geometric; continuous distributions, uniform, exponential, normal; distribution properties; engineering applications, noise modeling, failure rate estimation.

Unit IV
Sampling theory, population, sample statistics; sampling distributions; estimation theory;

confidence intervals; engineering measurement accuracy, data reliability, parameter estimation techniques.

Unit V

Hypothesis testing, null and alternative hypotheses; significance levels; tests for means, variances; correlation, regression analysis; engineering trend prediction, data-driven decision processes.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and Statistics for Engineers and Scientists* (9th ed.). Pearson.
2. Devore, J. L. (2016). *Probability and Statistics for Engineering and the Sciences* (9th ed.). Cengage.
3. Gupta, S. C., & Kapoor, V. K. (2018). *Fundamentals of Mathematical Statistics*. Sultan Chand.
4. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.
5. Ross, S. M. (2014). *Introduction to Probability and Statistics for Engineers*. Academic Press.

Reference Books

1. Papoulis, A., & Pillai, S. U. (2014). *Probability, Random Variables, and Stochastic Processes*. McGraw-Hill.
2. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2015). *Probability and Statistical Inference*. Pearson.
3. Johnson, R. A., & Wichern, D. W. (2014). *Applied Multivariate Statistical Analysis*. Pearson.
4. Mood, A. M., Graybill, F. A., & Boes, D. C. (2016). *Introduction to the Theory of Statistics*. McGraw-Hill.
5. Spiegel, M. R., Schiller, J. J., & Srinivasan, R. A. (2017). *Probability and Statistics* (Schaum's Outline). McGraw-Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

MATERIALS SCIENCE FOR ELECTRONICS

Course Category:
Engineering Science Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Electronic material property understanding
2. Crystal structure analysis
3. Defect and diffusion concepts
4. Electrical and thermal material behavior
5. Materials selection for electronics

Course Outcomes
CO1: Explain crystal structures and bonding
CO2: Analyze defects and diffusion mechanisms
CO3: Evaluate electrical properties of materials
CO4: Correlate thermal behavior with applications
CO5: Select materials for electronic systems

Detailed Syllabus

Unit I
Atomic bonding, ionic, covalent, metallic bonds; crystal structures, unit cells; Bravais lattices; Miller indices; electronic material classification, structural relevance.

Unit II
Imperfections in solids; point defects, line defects; diffusion mechanisms; Fick's laws; material processing relevance, impurity control, property modification.

Unit III
Electrical properties; conductors, semiconductors, insulators; carrier concentration; mobility; resistivity; temperature effects; electronic material performance evaluation.

Unit IV
Thermal properties; heat capacity, thermal conductivity; phonons; thermal expansion; heat dissipation relevance, reliability considerations.

Unit V
Dielectric and magnetic properties; polarization mechanisms; magnetic materials; hysteresis; electronic component applications, functional material selection.

Text Books

1. Callister, W. D., & Rethwisch, D. G. (2018). *Materials Science and Engineering* (9th ed.). Wiley.
2. Kasap, S. (2017). *Principles of Electronic Materials and Devices*. McGraw-Hill.
3. Smith, W. F., & Hashemi, J. (2011). *Foundations of Materials Science and Engineering*. McGraw-Hill.
4. Solymar, L., & Walsh, D. (2014). *Electrical Properties of Materials*. Oxford.
5. Shackelford, J. F. (2015). *Introduction to Materials Science for Engineers*. Pearson.

Reference Books

1. Kittel, C. (2018). *Introduction to Solid State Physics*. Wiley.
2. Ashby, M. F., & Jones, D. R. H. (2013). *Engineering Materials*. Butterworth-Heinemann.
3. Rao, C. N. R. (2014). *Materials Chemistry*. Springer.
4. Van Vlack, L. H. (2001). *Elements of Materials Science and Engineering*. Addison-Wesley.
5. Chiang, Y. M., Birnie, D., & Kingery, W. (1997). *Physical Ceramics*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

DIGITAL ELECTRONICS & LOGIC DESIGN

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Digital logic fundamentals
2. Boolean algebra application
3. Combinational circuit design
4. Sequential logic understanding
5. Digital system analysis

Course Outcomes
CO1: Apply number systems and codes
CO2: Simplify logic using Boolean algebra

CO3: Design combinational circuits
CO4: Analyze sequential circuits
CO5: Understand digital IC characteristics

Detailed Syllabus

Unit I
Number systems, binary, octal, hexadecimal; conversions; binary arithmetic; signed numbers; codes, BCD, Gray; digital representation relevance.

Unit II
Boolean algebra; logic gates; Boolean expressions; simplification techniques; Karnaugh maps; minimization efficiency, logical consistency.

Unit III
Combinational circuits; adders, subtractors; multiplexers, demultiplexers; encoders, decoders; digital arithmetic and data routing.

Unit IV
Sequential circuits; latches, flip-flops; counters, registers; timing diagrams; clocking concepts; state behavior analysis.

Unit V
Logic families; TTL, CMOS characteristics; noise margins; power dissipation; interfacing basics; digital IC performance considerations.

Text Books

1. Morris Mano, M., & Ciletti, M. D. (2017). *Digital Design* (6th ed.). Pearson.
2. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2016). *Digital Systems*. Pearson.
3. Floyd, T. L. (2014). *Digital Fundamentals*. Pearson.
4. Wakerly, J. F. (2018). *Digital Design*. Pearson.
5. Roth, C. H., & Kinney, L. L. (2014). *Fundamentals of Logic Design*. Cengage.

Reference Books

1. Katz, R. H., & Borriello, G. (2015). *Contemporary Logic Design*. Pearson.
2. Brown, S., & Vranesic, Z. (2014). *Fundamentals of Digital Logic*. McGraw-Hill.
3. Jain, R. P. (2016). *Modern Digital Electronics*. McGraw-Hill.
4. Salivahanan, S., Kumar, S. S., & Vallavaraj, A. (2019). *Digital Logic Design*. McGraw-Hill.
5. Gothmann, W. H. (1971). *Digital Electronics*. Prentice Hall.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

OBJECT-ORIENTED PROGRAMMING

Course Category:
Engineering Science Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Object-oriented thinking development
2. Class and object design skills
3. Code reusability principles
4. Exception handling competence
5. Foundation for software systems

Course Outcomes
CO1: Apply object-oriented concepts
CO2: Design classes and objects
CO3: Implement inheritance and polymorphism
CO4: Handle exceptions and files
CO5: Develop modular programs

Detailed Syllabus

Unit I
Object-oriented paradigm; classes, objects; data abstraction, encapsulation; program structure; software modeling relevance.

Unit II
Constructors, destructors; inheritance types; method overriding; code reuse principles; hierarchical design consistency.

Unit III
Polymorphism; virtual functions; interfaces; dynamic binding; extensibility, flexibility in software systems.

Unit IV
Exception handling; try-catch mechanisms; user-defined exceptions; robustness; error control strategies.

Unit V
File handling; input-output streams; basic libraries; simple applications; software engineering relevance.

Text Books

1. Balagurusamy, E. (2019). *Object Oriented Programming with C++*. McGraw-Hill.

2. Stroustrup, B. (2014). *The C++ Programming Language*. Addison-Wesley.
3. Deitel, P., & Deitel, H. (2017). *Java: How to Program*. Pearson.
4. Horstmann, C. S. (2018). *Core Java*. Pearson.
5. Lafore, R. (2017). *Object-Oriented Programming in C++*. SAMS.

Reference Books

1. Meyer, B. (2016). *Object-Oriented Software Construction*. Pearson.
2. Booch, G. (2007). *Object-Oriented Analysis and Design*. Addison-Wesley.
3. Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (2015). *Design Patterns*. Pearson.
4. Schildt, H. (2018). *Java: The Complete Reference*. McGraw-Hill.
5. Lippman, S. B. (2013). *C++ Primer*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

NETWORK THEORY & BASIC CIRCUITS

Course Category:
Engineering Science Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Circuit modeling competence
2. Network analysis techniques
3. Transient response understanding
4. AC circuit behavior analysis
5. Engineering problem-solving skills

Course Outcomes
CO1: Apply circuit laws
CO2: Analyze DC and AC networks
CO3: Use network theorems
CO4: Evaluate transient responses
CO5: Analyze resonance phenomena

Detailed Syllabus

Unit I
Circuit elements; sources, resistors; Kirchhoff laws; network terminology; lumped parameter systems; analytical formulation relevance.

Unit II
Network theorems; Superposition, Thevenin, Norton; source transformation; maximum power transfer; simplification efficiency.

Unit III
Transient analysis; RL, RC, RLC circuits; natural and forced response; time constants; dynamic behavior modeling.

Unit IV
AC circuits; phasors; impedance; power analysis; resonance; frequency response characteristics.

Unit V
Two-port networks; parameters; interconnections; network functions; filter fundamentals; system-level analysis.

Text Books

1. Van Valkenburg, M. E. (2015). *Network Analysis*. Pearson.
2. Hayt, W. H., Kemmerly, J. E., & Durbin, S. M. (2018). *Engineering Circuit Analysis*. McGraw-Hill.
3. Alexander, C. K., & Sadiku, M. N. O. (2017). *Fundamentals of Electric Circuits*. McGraw-Hill.
4. Nahvi, M., & Edminister, J. (2013). *Electric Circuits*. McGraw-Hill.
5. Boylestad, R. (2015). *Introductory Circuit Analysis*. Pearson.

Reference Books

1. Dorf, R. C., & Svoboda, J. A. (2014). *Introduction to Electric Circuits*. Wiley.
2. Skilling, H. H. (1965). *Electrical Engineering Circuits*. Wiley.
3. Chua, L. O., Desoer, C. A., & Kuh, E. S. (1987). *Linear and Nonlinear Circuits*. McGraw-Hill.
4. Guillemin, E. A. (1957). *Synthesis of Passive Networks*. Wiley.
5. Bellman, R. (1960). *Introduction to Matrix Analysis*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

DESIGN THINKING & INNOVATION

Course Category:
Humanities & Management Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Creative problem-solving skills
2. User-centric design approach
3. Innovation methodologies
4. Team-based ideation capability
5. Entrepreneurial mindset development

Course Outcomes
CO1: Apply design thinking stages
CO2: Identify user needs
CO3: Generate innovative solutions
CO4: Develop prototypes
CO5: Evaluate feasibility and impact

Detailed Syllabus

Unit I
Design thinking concepts; problem identification; empathy mapping; stakeholder analysis; innovation context awareness.

Unit II
Ideation techniques; brainstorming; lateral thinking; creativity tools; solution diversity generation.

Unit III
Prototyping methods; low-fidelity models; iteration cycles; validation approaches; design refinement.

Unit IV
Testing and feedback; user evaluation; performance metrics; improvement strategies; practical feasibility.

Unit V
Innovation management; intellectual property basics; entrepreneurship overview; societal impact; sustainable innovation.

Text Books

1. Brown, T. (2009). *Change by Design*. HarperCollins.

2. Kelley, T., & Kelley, D. (2013). *Creative Confidence*. Crown Business.
3. Liedtka, J., Ogilvie, T., & Brozenske, R. (2014). *Designing for Growth*. Columbia.
4. Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation*. Wiley.
5. Tidd, J., & Bessant, J. (2018). *Managing Innovation*. Wiley.

Reference Books

1. Norman, D. A. (2013). *The Design of Everyday Things*. Basic Books.
2. Martin, R. L. (2009). *The Design of Business*. Harvard.
3. Kelley, T. (2001). *The Art of Innovation*. Currency.
4. Ries, E. (2011). *The Lean Startup*. Crown.
5. Drucker, P. F. (2007). *Innovation and Entrepreneurship*. Butterworth-Heinemann.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

INTERNSHIP / INDUSTRIAL ORIENTATION

Course Category:
Internship / Industrial Training Course

Credits / Contact Hours:
1 Credit / 15 Contact Hours

Course Objectives

1. Industrial exposure awareness
2. Professional practice understanding
3. Organizational workflow familiarity
4. Safety and ethics orientation
5. Career readiness preparation

Course Outcomes
CO1: Understand industrial environments
CO2: Observe professional practices
CO3: Relate theory to practice
CO4: Follow safety and ethical norms
CO5: Document industrial learning

Guidelines
• Minimum two weeks industrial / laboratory exposure

• Approved industry or research organization
• Faculty mentor allocation mandatory
• Maintenance of internship diary
• Submission of completion certificate and report

Evaluation Scheme
Continuous Assessment (100%)

III SEMESTER — B.Tech. Semiconductor Technology & Chip Design (20 CREDITS)

ENGINEERING MATHEMATICS III (TRANSFORMS & NUMERICAL METHODS)

Course Category:
Basic Science Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Transform techniques for engineering analysis
2. Numerical solution of engineering equations
3. Approximation methods for complex systems
4. Error analysis and stability understanding
5. Computational foundations for core engineering courses

Course Outcomes
CO1: Apply Laplace transforms to engineering systems
CO2: Use Fourier series and transforms effectively
CO3: Solve equations using numerical methods
CO4: Apply numerical integration and differentiation
CO5: Analyze errors and convergence behavior

Detailed Syllabus

Unit I
Laplace transform fundamentals, existence conditions; transforms of standard functions; linearity, shifting properties; inverse Laplace transform techniques; engineering applications in circuit analysis, dynamic system modeling, initial value problems.

Unit II
Fourier series representation; even and odd functions; half range expansions; Fourier transform concepts; spectral representation, frequency domain interpretation; engineering signal analysis, periodic waveform characterization.

Unit III
Numerical solution of algebraic equations; bisection, regula falsi; Newton–Raphson method; convergence criteria; computational efficiency, solution accuracy, iterative stability, engineering problem relevance.

Unit IV
Numerical differentiation; finite differences; numerical integration; trapezoidal rule,

Simpson's rules; approximation accuracy, error estimation; engineering data processing, experimental analysis applications.

Unit V
Numerical solutions of ordinary differential equations; Euler method; Runge–Kutta methods; predictor–corrector techniques; step size control, stability considerations, engineering system simulation.

Text Books

1. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley.
2. Jain, R. K., & Iyengar, S. R. K. (2014). *Advanced Engineering Mathematics*. Narosa.
3. Sastry, S. S. (2012). *Introductory Methods of Numerical Analysis*. PHI.
4. Chapra, S. C., & Canale, R. P. (2015). *Numerical Methods for Engineers*. McGraw-Hill.
5. Grewal, B. S. (2015). *Higher Engineering Mathematics*. Khanna.

Reference Books

1. Zill, D. G., & Cullen, M. R. (2013). *Advanced Engineering Mathematics*. Jones & Bartlett.
2. Burden, R. L., & Faires, J. D. (2016). *Numerical Analysis*. Cengage.
3. Boylestad, R. (2015). *Engineering Mathematics Applications*. Pearson.
4. Spiegel, M. R. (2014). *Laplace Transforms* (Schaum's Outline). McGraw-Hill.
5. Poularikas, A. D. (2010). *The Transforms and Applications Handbook*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

ELECTRONIC DEVICES & CIRCUITS

Course Category:
Core Engineering Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Semiconductor device operation principles
2. Diode and transistor characteristics understanding
3. Small signal circuit analysis

4. Biasing and amplification concepts
5. Foundation for analog and VLSI courses

Course Outcomes

CO1: Explain semiconductor device physics
CO2: Analyze diode circuits
CO3: Evaluate BJT and MOSFET characteristics
CO4: Design basic amplifier circuits
CO5: Interpret frequency response behavior

Detailed Syllabus

Unit I

Semiconductor basics; PN junction theory; depletion region; biasing conditions; diode characteristics; rectifiers; voltage regulation; practical limitations, efficiency considerations.

Unit II

Zener diodes; applications; clippers, clampers; switching characteristics; special diodes overview; circuit protection, waveform shaping relevance.

Unit III

Bipolar junction transistors; construction, operation modes; CE, CB, CC configurations; characteristics; biasing techniques; thermal stability considerations.

Unit IV

Field effect transistors; JFET, MOSFET structures; characteristics; biasing; small signal models; amplification behavior, device comparison.

Unit V

Amplifiers; small signal analysis; frequency response; multistage amplifiers; coupling methods; gain-bandwidth tradeoff, practical design constraints.

Text Books

1. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic Circuits*. Oxford.
2. Boylestad, R. L., & Nashelsky, L. (2015). *Electronic Devices and Circuit Theory*. Pearson.
3. Streetman, B. G., & Banerjee, S. (2016). *Solid State Electronic Devices*. Pearson.
4. Neamen, D. A. (2012). *Electronic Circuit Analysis and Design*. McGraw-Hill.
5. Millman, J., & Halkias, C. (2011). *Integrated Electronics*. McGraw-Hill.

Reference Books

1. Sze, S. M., & Ng, K. K. (2006). *Physics of Semiconductor Devices*. Wiley.
2. Jaeger, R. C., & Blalock, T. N. (2010). *Microelectronic Circuit Design*. McGraw-Hill.

3. Horowitz, P., & Hill, W. (2015). *The Art of Electronics*. Cambridge.
4. Rashid, M. H. (2014). *Microelectronic Circuits*. Cengage.
5. Tsividis, Y. (2011). *Operation and Modeling of the MOS Transistor*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

ANALOG ELECTRONICS

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Analog circuit building block understanding
2. Operational amplifier applications
3. Feedback and stability concepts
4. Oscillator and waveform generation
5. Analog system performance evaluation

Course Outcomes
CO1: Analyze operational amplifier characteristics
CO2: Design amplifier applications
CO3: Apply feedback principles
CO4: Analyze oscillators and waveform generators
CO5: Evaluate analog circuit performance

Detailed Syllabus

Unit I
Operational amplifiers; ideal and practical characteristics; parameters; limitations; equivalent models; analog signal amplification fundamentals.

Unit II
Op-amp applications; inverting, non-inverting amplifiers; summing, integrator, differentiator; signal conditioning relevance.

Unit III
Feedback amplifiers; types; gain stability; bandwidth improvement; noise considerations; control of system behavior.

Unit IV
Oscillators; RC, LC, crystal oscillators; conditions for oscillation; frequency stability; waveform generation.

Unit V
Multivibrators; astable, monostable, bistable circuits; waveform shaping; timing analysis; analog timing applications.

Text Books

1. Gayakwad, R. A. (2015). *Op-Amps and Linear Integrated Circuits*. Pearson.
2. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic Circuits*. Oxford.
3. Franco, S. (2015). *Design with Operational Amplifiers*. McGraw-Hill.
4. Malvino, A. (2014). *Electronic Principles*. McGraw-Hill.
5. Millman, J., & Grabel, A. (2010). *Microelectronics*. McGraw-Hill.

Reference Books

1. Horowitz, P., & Hill, W. (2015). *The Art of Electronics*. Cambridge.
2. Tocci, R. J. (2016). *Digital Systems*. Pearson.
3. Laker, K. R., & Sansen, W. (2014). *Design of Analog Integrated Circuits*. McGraw-Hill.
4. Gray, P. R., & Meyer, R. G. (2010). *Analysis and Design of Analog Integrated Circuits*. Wiley.
5. Rashid, M. H. (2014). *Microelectronic Circuits*. Cengage.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SIGNALS & SYSTEMS

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Signal representation understanding
2. System characterization techniques
3. Time and frequency domain analysis

4. Transform-based analysis skills
5. Foundation for communication and VLSI systems

Course Outcomes

CO1: Classify and represent signals
CO2: Analyze linear time-invariant systems
CO3: Apply convolution techniques
CO4: Use transform methods effectively
CO5: Interpret frequency domain behavior

Detailed Syllabus

Unit I

Signal classification; continuous, discrete signals; basic operations; standard signals; energy, power concepts; engineering signal representation relevance.

Unit II

System classification; linearity, time invariance; causality, stability; impulse response; interconnection of systems.

Unit III

Convolution operation; graphical interpretation; properties; continuous and discrete time convolution; system response analysis.

Unit IV

Fourier series and transforms; spectral analysis; frequency response; bandwidth concepts; signal distortion evaluation.

Unit V

Laplace and Z-transforms; region of convergence; system analysis; transfer functions; pole-zero interpretation.

Text Books

1. Oppenheim, A. V., & Willsky, A. S. (2015). *Signals and Systems*. Pearson.
2. Lathi, B. P. (2017). *Linear Systems and Signals*. Oxford.
3. Haykin, S., & Van Veen, B. (2012). *Signals and Systems*. Wiley.
4. Hsu, H. P. (2014). *Signals and Systems*. McGraw-Hill.
5. Roberts, M. J. (2012). *Signals and Systems*. McGraw-Hill.

Reference Books

1. Papoulis, A. (2002). *Signal Analysis*. McGraw-Hill.
2. Carlson, A. B. (2010). *Communication Systems*. McGraw-Hill.
3. Proakis, J. G., & Manolakis, D. G. (2007). *Digital Signal Processing*. Pearson.

4. McClellan, J. H. (2015). *DSP First*. Pearson.
5. Orfanidis, S. J. (2010). *Introduction to Signal Processing*. Prentice Hall.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMICONDUCTOR MATERIALS & CRYSTAL GROWTH

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Semiconductor material structure understanding
2. Crystal growth techniques knowledge
3. Purity and defect control concepts
4. Material characterization basics
5. Foundation for fabrication processes

Course Outcomes
CO1: Explain semiconductor crystal structures
CO2: Describe crystal growth methods
CO3: Analyze defects and impurities
CO4: Understand material characterization techniques
CO5: Relate material properties to device performance

Detailed Syllabus

Unit I
Semiconductor materials classification; elemental, compound semiconductors; crystal structures; lattice parameters; bandgap relevance.

Unit II
Crystal growth principles; melt growth; Czochralski method; Bridgman technique; solidification control.

Unit III
Vapor phase growth; epitaxy concepts; CVD methods; thin film deposition relevance.

Unit IV
Defects in crystals; point, line, planar defects; impurity incorporation; defect control importance.

Unit V
Material characterization; X-ray diffraction; electron microscopy basics; electrical measurements; quality assessment.

Text Books

1. Sze, S. M. (2010). *VLSI Technology*. McGraw-Hill.
2. Runyan, W. R., & Bean, K. E. (1994). *Semiconductor Integrated Circuit Processing Technology*. Addison-Wesley.
3. Campbell, S. A. (2008). *Fabrication Engineering at the Micro- and Nanoscale*. Oxford.
4. Streetman, B. G., & Banerjee, S. (2016). *Solid State Electronic Devices*. Pearson.
5. Ohring, M. (2002). *Materials Science of Thin Films*. Academic Press.

Reference Books

1. Madelung, O. (2004). *Semiconductors: Data Handbook*. Springer.
2. Hull, R. (2001). *Properties of Crystalline Silicon*. INSPEC.
3. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.
4. Kittel, C. (2018). *Introduction to Solid State Physics*. Wiley.
5. Singh, J. (2010). *Semiconductor Devices*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

HUMANITIES ELECTIVE (ETHICS / INDIAN CONSTITUTION)

Course Category:
Humanities & Management Course

Credits / Contact Hours:
2 Credits / 30 Contact Hours

Course Objectives

1. Ethical awareness in engineering practice
2. Constitutional values understanding
3. Social responsibility development
4. Professional conduct standards
5. Citizenship and governance knowledge

Course Outcomes

CO1: Apply ethical principles in engineering
CO2: Understand constitutional values
CO3: Recognize professional responsibilities
CO4: Analyze societal impacts of technology
CO5: Practice responsible citizenship

Detailed Syllabus

Unit I

Ethics concepts; moral philosophy; professional ethics; values; integrity; ethical decision frameworks.

Unit II

Engineering ethics; professional codes; case studies; safety, accountability; public welfare relevance.

Unit III

Indian Constitution overview; preamble; fundamental rights; duties; governance structure.

Unit IV

State policy principles; democracy; secularism; social justice; constitutional institutions.

Unit V

Technology and society; legal responsibilities; environmental ethics; sustainable development; civic awareness.

Text Books

1. Govindarajan, M., Natarajan, S., & Senthil Kumar, V. S. (2013). *Engineering Ethics*. PHI.
2. Subramanian, R. (2018). *Professional Ethics and Human Values*. Oxford.
3. Basu, D. D. (2016). *Introduction to the Constitution of India*. LexisNexis.
4. Padhy, P. N. (2017). *Indian Constitution*. PHI.
5. Martin, M. W., & Schinzinger, R. (2014). *Ethics in Engineering*. McGraw-Hill.

Reference Books

1. Velasquez, M. (2018). *Business Ethics*. Pearson.
2. Rawls, J. (2012). *A Theory of Justice*. Harvard.
3. Baradat, L. P. (2014). *Political Ideologies*. Routledge.
4. Harris, C. E. (2013). *Engineering Ethics*. Cengage.
5. Sandel, M. J. (2010). *Justice*. Penguin.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

INTERNSHIP

Course Category:
Internship / Industrial Training Course

Credits / Contact Hours:
1 Credit / 15 Contact Hours

Course Objectives

1. Practical exposure to engineering environment
2. Application of classroom knowledge
3. Professional skill development
4. Industry–academia linkage
5. Career orientation enhancement

Course Outcomes
CO1: Observe industrial practices
CO2: Apply engineering concepts practically
CO3: Demonstrate professional discipline
CO4: Identify real-world engineering problems
CO5: Document internship learning outcomes

Guidelines
• Internship during vacation or semester as notified
• Minimum two weeks duration
• Industry or research organization approval
• Faculty mentor monitoring
• Submission of report and completion certificate

Evaluation Scheme
Continuous Assessment (100%)

IV SEMESTER — B.TECH. SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN (20 CREDITS)

INTEGRATED CIRCUITS & APPLICATIONS

Course Category:
Core Engineering Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Integrated circuit fundamentals understanding
2. Linear and digital IC operation principles
3. IC application-oriented circuit analysis
4. Performance parameter evaluation
5. Foundation for VLSI and system design courses

Course Outcomes
CO1: Explain IC fabrication and classification
CO2: Analyze linear integrated circuits
CO3: Design IC-based functional circuits
CO4: Evaluate IC performance parameters
CO5: Apply ICs in practical engineering systems

Detailed Syllabus

Unit I
Integrated circuit concepts, classification; monolithic, hybrid ICs; fabrication overview; advantages, limitations; packaging basics; IC technology relevance, miniaturization benefits, system integration perspective.

Unit II
Operational amplifier ICs; internal architecture; characteristics, parameters; offset voltages, bias currents; frequency response; practical non-idealities, performance constraints, application relevance.

Unit III
Linear IC applications; amplifiers, comparators; integrators, differentiators; waveform generators; voltage regulators; functional circuit realization, design considerations, stability aspects.

Unit IV
Timer ICs; 555 architecture; monostable, astable configurations; duty cycle control; timing accuracy; application scenarios, signal generation relevance.

Unit V
Introduction to digital ICs; logic IC families; interfacing concepts; ADC, DAC basics; mixed-signal relevance, system-level integration considerations.

Text Books

1. Gayakwad, R. A. (2015). *Op-Amps and Linear Integrated Circuits*. Pearson.
2. Millman, J., & Halkias, C. (2011). *Integrated Electronics*. McGraw-Hill.
3. Franco, S. (2015). *Design with Operational Amplifiers*. McGraw-Hill.
4. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic Circuits*. Oxford.
5. Malvino, A. (2014). *Electronic Principles*. McGraw-Hill.

Reference Books

1. Horowitz, P., & Hill, W. (2015). *The Art of Electronics*. Cambridge.
2. Rashid, M. H. (2014). *Microelectronic Circuits*. Cengage.
3. Gray, P. R., & Meyer, R. G. (2010). *Analysis and Design of Analog Integrated Circuits*. Wiley.
4. Laker, K. R., & Sansen, W. (2014). *Design of Analog Integrated Circuits*. McGraw-Hill.
5. Jaeger, R. C., & Blalock, T. N. (2010). *Microelectronic Circuit Design*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

MICROPROCESSORS & MICROCONTROLLERS

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Microprocessor architecture understanding
2. Instruction set and programming concepts
3. Interfacing techniques knowledge

4. Microcontroller architecture familiarity
5. Embedded system foundation development

Course Outcomes

CO1: Explain microprocessor architecture
CO2: Write assembly-level programs
CO3: Design basic interfacing circuits
CO4: Understand microcontroller peripherals
CO5: Apply processors in embedded applications

Detailed Syllabus

Unit I

Microprocessor evolution; architecture overview; registers, ALU; buses; instruction cycle; memory organization; system-level perspective, functional relevance.

Unit II

Instruction set architecture; addressing modes; assembly language programming; program development steps; computational logic representation.

Unit III

Interfacing concepts; memory interfacing; I O interfacing; peripheral devices; timing considerations; system expansion relevance.

Unit IV

Microcontrollers overview; architecture comparison; on-chip peripherals; timers, counters; serial communication basics; embedded relevance.

Unit V

Applications; embedded system concepts; processor selection criteria; real-time considerations; practical implementation constraints.

Text Books

1. Gaonkar, R. S. (2013). *Microprocessor Architecture, Programming and Applications*. Wiley.
2. Liu, Y. C., & Gibson, G. A. (2012). *Microcomputer Systems*. Pearson.
3. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. (2014). *The 8051 Microcontroller and Embedded Systems*. Pearson.
4. Ray, A. K., & Bhurchandi, K. M. (2010). *Advanced Microprocessors and Peripherals*. McGraw-Hill.
5. Krishna Kant. (2016). *Microprocessors and Microcontrollers*. PHI.

Reference Books

1. Brey, B. B. (2014). *The Intel Microprocessors*. Pearson.

2. Ayala, K. J. (2009). *The 8051 Microcontroller*. Cengage.
3. Barret, S. F., & Pack, D. J. (2012). *Microcontrollers Fundamentals*. Morgan & Claypool.
4. Valvano, J. (2018). *Embedded Systems*. Cengage.
5. Wolf, W. (2012). *Computers as Components*. Morgan Kaufmann.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMICONDUCTOR DEVICE PHYSICS

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Physical principles of semiconductor devices
2. Carrier transport and recombination understanding
3. Junction and MOS physics knowledge
4. Device characteristics analysis
5. Foundation for VLSI and nanoelectronics courses

Course Outcomes
CO1: Explain carrier statistics and transport
CO2: Analyze PN junction behavior
CO3: Understand MOS capacitor physics
CO4: Evaluate basic semiconductor devices
CO5: Relate physics to device performance

Detailed Syllabus

Unit I
Carrier statistics; Fermi–Dirac distribution; intrinsic and extrinsic semiconductors; carrier concentration; temperature dependence; physical interpretation, material behavior relevance.

Unit II
Carrier transport mechanisms; drift, diffusion; mobility; conductivity; continuity equations; recombination, generation processes; physical consistency.

Unit III
PN junction physics; equilibrium conditions; depletion region; biasing effects; current mechanisms; junction capacitances; device behavior relevance.

Unit IV
Metal semiconductor junctions; Schottky barriers; ohmic contacts; interface states; contact resistance; device integration importance.

Unit V
MOS capacitor fundamentals; energy band diagrams; accumulation, depletion, inversion; threshold voltage; interface effects; MOS device foundation.

Text Books

1. Neamen, D. A. (2012). *Semiconductor Physics and Devices*. McGraw-Hill.
2. Streetman, B. G., & Banerjee, S. (2016). *Solid State Electronic Devices*. Pearson.
3. Sze, S. M., & Ng, K. K. (2006). *Physics of Semiconductor Devices*. Wiley.
4. Pierret, R. F. (2014). *Semiconductor Device Fundamentals*. Addison-Wesley.
5. Singh, J. (2010). *Semiconductor Devices*. Wiley.

Reference Books

1. Kittel, C. (2018). *Introduction to Solid State Physics*. Wiley.
2. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.
3. Yu, P. Y., & Cardona, M. (2010). *Fundamentals of Semiconductors*. Springer.
4. Wolfe, C. M., Holonyak, N., & Stillman, G. E. (2012). *Physical Properties of Semiconductors*. Prentice Hall.
5. Madelung, O. (2004). *Semiconductors: Data Handbook*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

DIGITAL SYSTEM DESIGN

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Structured digital system design skills

2. Combinational and sequential logic synthesis
3. Timing and performance analysis
4. Programmable logic awareness
5. Preparation for VLSI design courses

Course Outcomes

CO1: Design combinational logic systems
CO2: Analyze sequential circuits
CO3: Apply state machine concepts
CO4: Evaluate timing parameters
CO5: Understand programmable logic devices

Detailed Syllabus

Unit I

Combinational logic design; arithmetic circuits; comparators; multiplexers; decoders; structured logic realization, optimization relevance.

Unit II

Sequential logic design; flip-flops; registers; counters; timing diagrams; synchronous operation concepts.

Unit III

State machines; Moore, Mealy models; state reduction; state assignment; sequential system synthesis.

Unit IV

Timing analysis; propagation delay; setup, hold times; clock skew; hazards; reliable system operation considerations.

Unit V

Programmable logic devices; PLA, PAL, CPLD, FPGA overview; configuration concepts; application relevance.

Text Books

1. Morris Mano, M., & Ciletti, M. D. (2017). *Digital Design*. Pearson.
2. Wakerly, J. F. (2018). *Digital Design*. Pearson.
3. Brown, S., & Vranesic, Z. (2014). *Fundamentals of Digital Logic*. McGraw-Hill.
4. Roth, C. H., & Kinney, L. L. (2014). *Fundamentals of Logic Design*. Cengage.
5. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2016). *Digital Systems*. Pearson.

Reference Books

1. Katz, R. H., & Borriello, G. (2015). *Contemporary Logic Design*. Pearson.

2. Salivahanan, S., Kumar, S. S., & Vallavaraj, A. (2019). *Digital Logic Design*. McGraw-Hill.
3. Jain, R. P. (2016). *Modern Digital Electronics*. McGraw-Hill.
4. De Micheli, G. (2011). *Synthesis and Optimization of Digital Circuits*. McGraw-Hill.
5. Hennessy, J. L., & Patterson, D. A. (2017). *Computer Architecture*. Morgan Kaufmann.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

OPEN ELECTIVE I (AI / IOT / DATA ANALYTICS)

Course Category:
Open Elective Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Interdisciplinary technology exposure
2. Awareness of emerging computing domains
3. Data-driven problem understanding
4. System-level thinking development
5. Application-oriented knowledge acquisition

Course Outcomes
CO1: Understand fundamentals of selected domain
CO2: Analyze application scenarios
CO3: Apply basic tools and concepts
CO4: Interpret interdisciplinary impact
CO5: Relate elective knowledge to core engineering

Detailed Syllabus

Unit I
Artificial intelligence overview; intelligent systems; data representation; basic learning concepts; application landscape relevance.

Unit II
Internet of Things concepts; sensors, actuators; communication models; system architecture; connectivity relevance.

Unit III
Data analytics fundamentals; data types; preprocessing; visualization; descriptive analytics; engineering decision relevance.

Unit IV
Algorithms overview; supervised, unsupervised learning; basic models; performance metrics; practical interpretation.

Unit V
Case studies; interdisciplinary applications; ethical considerations; societal impact; future technology trends.

Text Books

1. Russell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach*. Pearson.
2. Han, J., Kamber, M., & Pei, J. (2012). *Data Mining*. Morgan Kaufmann.
3. Bahga, A., & Madisetti, V. (2014). *Internet of Things*. VPT.
4. Provost, F., & Fawcett, T. (2013). *Data Science for Business*. O'Reilly.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.

Reference Books

1. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
2. Mitchell, T. (1997). *Machine Learning*. McGraw-Hill.
3. Tan, P. N., Steinbach, M., & Kumar, V. (2016). *Introduction to Data Mining*. Pearson.
4. Minerva, R., Biru, A., & Rotondi, D. (2015). *Towards a Definition of IoT*. IEEE.
5. Floridi, L. (2014). *The Ethics of Information*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

ELECTRONICS LABORATORY

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Practical understanding of electronic circuits
2. Measurement and instrumentation skills

3. Device characteristic evaluation
4. Circuit troubleshooting competence
5. Laboratory safety and documentation discipline

Course Outcomes

CO1: Perform electronic experiments safely
CO2: Measure electrical parameters accurately
CO3: Analyze experimental results
CO4: Relate theory with practical observations
CO5: Prepare professional laboratory records

List of Experiments / Exercises

1. Study and verification of V I characteristics of PN junction diode using regulated power supply, multimeter, and characteristic plotting techniques.
2. Measurement of Zener diode characteristics and voltage regulation behavior under varying load conditions using standard laboratory instruments.
3. Half-wave and full-wave rectifier circuits construction and performance evaluation including ripple factor and efficiency calculations.
4. BJT input and output characteristics measurement in CE configuration using curve tracer or discrete setup.
5. MOSFET drain and transfer characteristics analysis focusing on threshold voltage and operating regions.
6. Design and testing of single-stage RC coupled amplifier measuring gain and frequency response parameters.
7. Operational amplifier parameter measurement including offset voltage, slew rate, and bandwidth using standard test circuits.
8. Implementation of op-amp based applications such as integrator and differentiator with performance verification.
9. Logic gate verification using digital ICs and truth table validation with proper interfacing.
10. Study of basic digital circuits such as adders and multiplexers using IC trainer kits.

Expected Outcomes

Improved practical proficiency, measurement accuracy, analytical capability, troubleshooting skills, and professional laboratory practice awareness.

Evaluation Scheme

Continuous Assessment (100%)

INTERNSHIP

Course Category:
Internship / Industrial Training Course

Credits / Contact Hours:
1 Credit / 15 Contact Hours

Course Objectives

1. Continued industrial exposure
2. Application of semiconductor fundamentals
3. Professional competency development
4. Industry process understanding
5. Career pathway clarification

Course Outcomes
CO1: Observe semiconductor industry practices
CO2: Apply classroom knowledge in practice
CO3: Demonstrate professional ethics
CO4: Identify industry-relevant problems
CO5: Report experiential learning outcomes

Guidelines
• Internship during semester or vacation period
• Minimum two weeks duration
• Approved industry or research organization
• Faculty supervision mandatory
• Submission of report and completion certificate

Evaluation Scheme
Continuous Assessment (100%)

V SEMESTER — B.TECH. SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN (20 CREDITS)

VLSI Design Fundamentals

Course Category:
Core Engineering Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Fundamentals of VLSI design methodologies
2. CMOS logic design principles
3. Digital circuit performance metrics
4. Layout and design rule awareness
5. Foundation for advanced chip design courses

Course Outcomes
CO1: Explain VLSI design flow and abstraction levels
CO2: Analyze CMOS logic circuits
CO3: Evaluate delay, power, and area trade-offs
CO4: Apply design rules in layout concepts
CO5: Relate circuit design to fabrication constraints

Detailed Syllabus

Unit I
VLSI design concepts; evolution, integration levels; design hierarchy; abstraction levels; design flow; front-end, back-end overview; CAD tools relevance, design productivity, system complexity management.

Unit II
MOS transistor as switch; CMOS inverter analysis; voltage transfer characteristics; noise margins; static, dynamic behavior; switching thresholds, logic robustness, power dissipation fundamentals.

Unit III
Combinational CMOS logic; NAND, NOR structures; complex gates; pass transistor logic; transmission gates; logic realization efficiency, transistor sizing considerations, performance trade-offs.

Unit IV
Sequential circuits; latches, flip-flops; clocking strategies; timing parameters; setup, hold constraints; metastability; synchronous design reliability, timing closure relevance.

Unit V
Introduction to VLSI layout; design rules; stick diagrams; lambda rules; parasitics; interconnect effects; layout versus schematic consistency, manufacturability considerations.

Text Books

1. Weste, N. H. E., & Harris, D. (2011). *CMOS VLSI Design* (4th ed.). Pearson.
2. Kang, S. M., & Leblebici, Y. (2003). *CMOS Digital Integrated Circuits*. McGraw-Hill.
3. Rabaey, J. M., Chandrakasan, A., & Nikolic, B. (2012). *Digital Integrated Circuits*. Pearson.
4. Smith, M. J. S. (1997). *Application-Specific Integrated Circuits*. Addison-Wesley.
5. Baker, R. J. (2010). *CMOS: Circuit Design, Layout, and Simulation*. Wiley.

Reference Books

1. Wolf, W. (2008). *Modern VLSI Design*. Pearson.
2. Chandrakasan, A., Bowhill, W., & Fox, F. (2001). *Design of High-Performance Microprocessor Circuits*. IEEE.
3. Uyemura, J. (2002). *Introduction to VLSI Circuits and Systems*. Wiley.
4. Pucknell, D. A., & Eshraghian, K. (1994). *Basic VLSI Design*. PHI.
5. Lim, S. K. (2014). *Practical Problems in VLSI Physical Design Automation*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

CMOS TECHNOLOGY

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. CMOS fabrication process understanding
2. Device scaling concepts

3. Process integration knowledge
4. Technology parameter awareness
5. Foundation for semiconductor manufacturing courses

Course Outcomes
CO1: Describe CMOS fabrication steps
CO2: Analyze oxidation, diffusion, implantation processes
CO3: Understand lithography and etching techniques
CO4: Explain device scaling challenges
CO5: Relate process technology to device performance

Detailed Syllabus

Unit I
CMOS technology overview; nMOS, pMOS processes; CMOS well structures; process flow sequence; device isolation concepts; manufacturing relevance, yield considerations.

Unit II
Thermal oxidation; growth mechanisms; oxide quality; diffusion processes; impurity profiles; junction depth control; electrical property implications.

Unit III
Ion implantation; dose, energy control; annealing processes; defect recovery; dopant activation; process precision, uniformity considerations.

Unit IV
Lithography fundamentals; photoresists; mask alignment; resolution limits; etching techniques; wet, dry etching; pattern transfer accuracy.

Unit V
Advanced CMOS scaling; short channel effects; leakage currents; high-k dielectrics; strain engineering; technology evolution challenges.

Text Books

1. Sze, S. M., & Ng, K. K. (2006). *Physics of Semiconductor Devices*. Wiley.
2. Campbell, S. A. (2008). *Fabrication Engineering at the Micro- and Nanoscale*. Oxford.
3. Plummer, J. D., Deal, M. D., & Griffin, P. B. (2000). *Silicon VLSI Technology*. Prentice Hall.
4. Jaeger, R. C. (2002). *Introduction to Microelectronic Fabrication*. Pearson.
5. Runyan, W. R., & Bean, K. E. (1994). *Semiconductor Integrated Circuit Processing Technology*. Addison-Wesley.

Reference Books

1. Wolf, S., & Tauber, R. N. (2000). *Silicon Processing for the VLSI Era*. Lattice Press.
2. Streetman, B. G., & Banerjee, S. (2016). *Solid State Electronic Devices*. Pearson.
3. Madou, M. J. (2011). *Fundamentals of Microfabrication*. CRC Press.
4. Taur, Y., & Ning, T. H. (2013). *Fundamentals of Modern VLSI Devices*. Cambridge.
5. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMICONDUCTOR MANUFACTURING PROCESSES

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Semiconductor fabrication process understanding
2. Cleanroom practices awareness
3. Thin film deposition knowledge
4. Process integration concepts
5. Manufacturing yield and reliability insight

Course Outcomes
CO1: Explain wafer preparation processes
CO2: Describe thin film deposition techniques
CO3: Analyze patterning and etching methods
CO4: Understand process integration challenges
CO5: Relate manufacturing steps to device yield

Detailed Syllabus

Unit I
Semiconductor wafers; crystal orientation; wafer slicing, polishing; cleanroom environment; contamination control; manufacturing discipline, yield relevance.

Unit II
Thin film deposition; PVD, CVD methods; epitaxy basics; film properties; stress, uniformity; device fabrication relevance.

Unit III
Oxidation and diffusion processes; furnace operations; process control; junction formation; repeatability, reliability considerations.

Unit IV
Lithography processes; mask fabrication; alignment accuracy; resolution enhancement techniques; pattern fidelity importance.

Unit V
Etching and metallization; wet, dry etching; interconnect formation; planarization; CMP basics; backend integration.

Text Books

1. Jaeger, R. C. (2002). *Introduction to Microelectronic Fabrication*. Pearson.
2. Campbell, S. A. (2008). *Fabrication Engineering at the Micro- and Nanoscale*. Oxford.
3. Sze, S. M. (2010). *VLSI Technology*. McGraw-Hill.
4. Runyan, W. R., & Bean, K. E. (1994). *Semiconductor Integrated Circuit Processing Technology*. Addison-Wesley.
5. Plummer, J. D., Deal, M. D., & Griffin, P. B. (2000). *Silicon VLSI Technology*. Prentice Hall.

Reference Books

1. Madou, M. J. (2011). *Fundamentals of Microfabrication*. CRC Press.
2. Wolf, S., & Tauber, R. N. (2000). *Silicon Processing for the VLSI Era*. Lattice Press.
3. Ohring, M. (2002). *Materials Science of Thin Films*. Academic Press.
4. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.
5. Taur, Y., & Ning, T. H. (2013). *Fundamentals of Modern VLSI Devices*. Cambridge.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

HARDWARE DESCRIPTION LANGUAGES (VHDL / VERILOG)

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. HDL-based digital design skills
2. Behavioral and structural modeling understanding
3. Simulation and verification concepts
4. Synthesizable coding practices
5. Preparation for VLSI design projects

Course Outcomes
CO1: Write HDL code for digital circuits
CO2: Model combinational and sequential logic
CO3: Perform simulation and debugging
CO4: Understand synthesis constraints
CO5: Apply HDL in VLSI design flow

Detailed Syllabus

Unit I
HDL concepts; design abstraction; VHDL, Verilog comparison; modules, entities; ports, data types; digital modeling relevance.

Unit II
Behavioral modeling; concurrent statements; procedural blocks; conditional constructs; coding styles; simulation accuracy considerations.

Unit III
Structural modeling; component instantiation; hierarchical design; parameterization; modularity benefits, reuse relevance.

Unit IV
Sequential logic modeling; clocked processes; nonblocking assignments; finite state machines; timing behavior representation.

Unit V
Simulation and synthesis; testbenches; verification flow; synthesis constraints; FPGA targeting overview; practical design cycle.

Text Books

1. Palnitkar, S. (2003). *Verilog HDL*. Pearson.

2. Bhasker, J. (2010). *A VHDL Primer*. PHI.
3. Brown, S., & Vranesic, Z. (2014). *Fundamentals of Digital Logic with VHDL Design*. McGraw-Hill.
4. Samir Palnitkar. (2017). *Verilog HDL Synthesis*. Pearson.
5. Smith, D. (2010). *HDL Chip Design*. Doone.

Reference Books

1. Ashenden, P. J. (2010). *The Designer's Guide to VHDL*. Morgan Kaufmann.
2. Cummings, C. (2002). *Simulation and Synthesis Techniques*. SNUG.
3. Wakerly, J. F. (2018). *Digital Design*. Pearson.
4. Perry, D. L. (1994). *VHDL*. McGraw-Hill.
5. Navabi, Z. (2007). *Verilog Digital System Design*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

PROFESSIONAL ELECTIVE I (POWER DEVICES / MEMS)

Course Category:
Professional Elective Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Specialized domain knowledge acquisition
2. Device-level operational understanding
3. Application-driven analysis skills
4. Technology relevance awareness
5. Preparation for advanced electives

Course Outcomes
CO1: Explain principles of selected elective domain
CO2: Analyze device structures and behavior
CO3: Evaluate application requirements
CO4: Understand fabrication challenges
CO5: Relate elective knowledge to core engineering

Detailed Syllabus

Unit I
Power devices or MEMS overview; application domains; technology evolution; performance requirements; engineering relevance.

Unit II
Device structures; operational principles; material considerations; scaling aspects; functional behavior analysis.

Unit III
Fabrication techniques; process flow; packaging basics; reliability aspects; manufacturing constraints.

Unit IV
Characteristics and modeling; electrical, mechanical parameters; performance metrics; application suitability.

Unit V
Case studies; industrial applications; emerging trends; challenges; future scope considerations.

Text Books

1. Baliga, B. J. (2010). *Fundamentals of Power Semiconductor Devices*. Springer.
2. Senturia, S. D. (2001). *Microsystem Design*. Kluwer.
3. El-Hami, K., & Smith, A. (2015). *MEMS and Microsystems*. CRC Press.
4. Mohan, N., Undeland, T., & Robbins, W. (2012). *Power Electronics*. Wiley.
5. Madou, M. J. (2011). *Fundamentals of Microfabrication*. CRC Press.

Reference Books

1. Rashid, M. H. (2014). *Power Electronics*. Pearson.
2. Rebeiz, G. M. (2003). *RF MEMS*. Wiley.
3. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.
4. Sze, S. M. (2010). *VLSI Technology*. McGraw-Hill.
5. Kovacs, G. T. A. (1998). *Micromachined Transducers Sourcebook*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

MINOR PROJECT I (CHIP DESIGN SIMULATION)

Course Category:
Project Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Practical chip design exposure
2. Simulation tool proficiency
3. Design documentation skills
4. Team-based problem solving
5. Preparation for advanced projects

Course Outcomes
CO1: Formulate chip-level design problems
CO2: Use EDA tools for simulation
CO3: Analyze design performance metrics
CO4: Document technical work systematically
CO5: Present design outcomes professionally

Guidelines
• Problem identification in chip design domain
• Use of standard EDA simulation tools
• Weekly progress review by faculty mentor
• Design report preparation and submission
• Project demonstration and viva-voce

Evaluation Scheme
Continuous Assessment (100%)

VI SEMESTER — B.TECH. SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN (CREDITS 20)

ANALOG & MIXED SIGNAL VLSI DESIGN

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Analog CMOS circuit design understanding
2. Mixed signal system concepts
3. Performance trade-off evaluation
4. Noise and nonlinearity awareness
5. Preparation for advanced IC design

Course Outcomes
CO1: Analyze analog CMOS building blocks
CO2: Design basic analog integrated circuits
CO3: Evaluate noise and distortion effects
CO4: Understand mixed signal integration issues
CO5: Relate analog design to system specifications

Detailed Syllabus

Unit I
Analog VLSI design introduction; CMOS analog design challenges; device models; biasing techniques; current mirrors; analog performance metrics, gain, bandwidth, linearity, robustness considerations.

Unit II
Single stage amplifiers; common source, common gate, common drain; small signal models; gain analysis; frequency response; analog signal amplification behavior, design constraints.

Unit III
Differential amplifiers; differential pairs; active loads; common mode rejection; biasing strategies; operational amplifier foundations, symmetry considerations, noise immunity.

Unit IV
Operational amplifier architectures; two stage op-amps; compensation techniques; stability criteria; slew rate; gain bandwidth product; performance trade-offs, reliability aspects.

Unit V

Mixed signal circuits overview; ADC, DAC principles; sampling concepts; quantization effects; clock jitter; integration challenges, interface considerations, system level relevance.

Text Books

1. Razavi, B. (2016). *Design of Analog CMOS Integrated Circuits*. McGraw-Hill.
2. Gray, P. R., Hurst, P. J., Lewis, S. H., & Meyer, R. G. (2010). *Analysis and Design of Analog Integrated Circuits*. Wiley.
3. Laker, K. R., & Sansen, W. (2014). *Design of Analog Integrated Circuits and Systems*. McGraw-Hill.
4. Allen, P. E., & Holberg, D. R. (2011). *CMOS Analog Circuit Design*. Oxford.
5. Johns, D. A., & Martin, K. (2008). *Analog Integrated Circuit Design*. Wiley.

Reference Books

1. Baker, R. J. (2010). *CMOS: Circuit Design, Layout, and Simulation*. Wiley.
2. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic Circuits*. Oxford.
3. Sansen, W. (2006). *Analog Design Essentials*. Springer.
4. Franco, S. (2015). *Design with Operational Amplifiers*. McGraw-Hill.
5. Razavi, B. (2012). *RF Microelectronics*. Prentice Hall.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

DIGITAL IC DESIGN & VERIFICATION

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Advanced digital IC design concepts
2. Timing and power analysis understanding
3. Verification methodologies awareness
4. RTL to gate level flow knowledge
5. Preparation for SoC design

Course Outcomes

CO1: Design digital ICs at RTL level
CO2: Analyze timing and power metrics
CO3: Apply verification techniques
CO4: Understand synthesis and optimization
CO5: Relate design flow to fabrication

Detailed Syllabus

Unit I

Digital IC design flow; specification to implementation; RTL design; synthesis concepts; standard cell libraries; abstraction hierarchy, design productivity, constraint awareness.

Unit II

Timing analysis; clock definitions; setup, hold constraints; static timing analysis; clock tree basics; performance closure relevance, reliability considerations.

Unit III

Power dissipation; dynamic, static power; switching activity; low power design techniques; power gating, clock gating; energy efficiency relevance.

Unit IV

Verification concepts; functional verification; testbenches; simulation strategies; coverage metrics; design correctness assurance.

Unit V

Design for testability; fault models; scan chains; built-in self-test; manufacturability considerations; yield improvement relevance.

Text Books

1. Rabaey, J. M., Chandrakasan, A., & Nikolic, B. (2012). *Digital Integrated Circuits*. Pearson.
2. Weste, N. H. E., & Harris, D. (2011). *CMOS VLSI Design*. Pearson.
3. Bhasker, J. (2010). *A VHDL Primer*. PHI.
4. Palnitkar, S. (2003). *Verilog HDL*. Pearson.
5. Bushnell, M. L., & Agrawal, V. D. (2000). *Essentials of Electronic Testing*. Springer.

Reference Books

1. Wolf, W. (2008). *Modern VLSI Design*. Pearson.
2. Hennessy, J. L., & Patterson, D. A. (2017). *Computer Architecture*. Morgan Kaufmann.
3. Flynn, D. (2010). *ARM System-on-Chip Architecture*. Pearson.
4. Bergeron, J. (2012). *Writing Testbenches*. Springer.

5. Abramovici, M., Breuer, M. A., & Friedman, A. D. (1994). *Digital Systems Testing*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMICONDUCTOR PACKAGING & TESTING

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Semiconductor packaging concepts understanding
2. Interconnection technologies knowledge
3. Thermal and mechanical reliability awareness
4. Testing methodologies familiarity
5. Industry-oriented packaging insight

Course Outcomes
CO1: Explain semiconductor packaging types
CO2: Analyze interconnect technologies
CO3: Understand thermal management issues
CO4: Apply testing concepts
CO5: Relate packaging to device reliability

Detailed Syllabus

Unit I
Packaging overview; role in semiconductor systems; package functions; chip protection; electrical connectivity; industry relevance, performance considerations.

Unit II
Package types; DIP, QFP, BGA, CSP; wafer level packaging; selection criteria; miniaturization relevance.

Unit III
Interconnection technologies; wire bonding; flip chip; TSV concepts; electrical, mechanical behavior; reliability implications.

Unit IV
Thermal management; heat generation; thermal resistance; cooling techniques; package design considerations; device reliability relevance.

Unit V
Testing fundamentals; wafer probing; final testing; fault coverage; yield analysis; quality assurance importance.

Text Books

1. Tummala, R. R. (2001). *Fundamentals of Microsystems Packaging*. McGraw-Hill.
2. Lau, J. H. (2010). *Flip Chip Technologies*. McGraw-Hill.
3. Harper, C. A. (2004). *Electronic Packaging and Interconnection Handbook*. McGraw-Hill.
4. Sze, S. M. (2010). *VLSI Technology*. McGraw-Hill.
5. Pecht, M. (2009). *Reliability Engineering*. Wiley.

Reference Books

1. Geng, H. (2016). *Semiconductor Manufacturing Handbook*. McGraw-Hill.
2. Prasad, R. (2013). *Surface Mount Technology*. Springer.
3. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.
4. Wolf, S., & Tauber, R. N. (2000). *Silicon Processing for the VLSI Era*. Lattice Press.
5. McCluskey, P. (2018). *Handbook of Electronic Package Design*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

NANOELECTRONICS & ADVANCED DEVICES

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Nanoscale device physics understanding
2. Advanced semiconductor device concepts
3. Scaling limits awareness
4. Emerging device technologies exposure
5. Research-oriented perspective development

Course Outcomes

CO1: Explain nanoscale device behavior
CO2: Analyze advanced transistor structures
CO3: Understand quantum effects in devices
CO4: Evaluate emerging nanoelectronic devices
CO5: Relate advanced devices to future technology

Detailed Syllabus

Unit I

Nanoelectronics overview; scaling trends; Moore's law; physical limits; short channel effects; technology evolution relevance.

Unit II

Advanced MOSFETs; FinFETs; SOI devices; multigate structures; electrostatic control; performance enhancement relevance.

Unit III

Quantum effects; tunneling; quantum confinement; ballistic transport; nanoscale modeling; device behavior interpretation.

Unit IV

Carbon based devices; CNTFETs; graphene electronics; material properties; fabrication challenges; application prospects.

Unit V

Emerging devices; spintronics; molecular electronics; neuromorphic devices; research trends; future semiconductor landscape.

Text Books

1. Lundstrom, M. (2017). *Fundamentals of Nanotransistors*. World Scientific.
2. Taur, Y., & Ning, T. H. (2013). *Fundamentals of Modern VLSI Devices*. Cambridge.
3. Ferry, D. K., Goodnick, S. M., & Bird, J. (2009). *Transport in Nanostructures*. Cambridge.
4. Datta, S. (2005). *Quantum Transport*. Cambridge.
5. Wong, H. S. P., & Deen, M. J. (2014). *Nano-CMOS Circuit and Physical Design*. Wiley.

Reference Books

1. Sze, S. M., & Ng, K. K. (2006). *Physics of Semiconductor Devices*. Wiley.
2. Kittel, C. (2018). *Introduction to Solid State Physics*. Wiley.
3. Ionescu, A. M., & Riel, H. (2011). *Tunnel Field-Effect Transistors*. Nature.
4. Wolf, E. L. (2012). *Nanophysics and Nanotechnology*. Wiley.

5. Baliga, B. J. (2010). *Fundamentals of Power Semiconductor Devices*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

OPEN ELECTIVE II (PHOTONICS / EMBEDDED AI)

Course Category:
Open Elective Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Interdisciplinary advanced technology exposure
2. Awareness of photonics or embedded intelligence
3. Application-oriented understanding
4. System integration perspective
5. Technology trend familiarity

Course Outcomes
CO1: Explain fundamentals of chosen elective
CO2: Analyze application use cases
CO3: Apply basic tools and concepts
CO4: Understand interdisciplinary challenges
CO5: Relate elective knowledge to semiconductor systems

Detailed Syllabus

Unit I
Photonics or embedded AI overview; technology scope; system components; application drivers; interdisciplinary relevance.

Unit II
Core principles; optical sources, detectors or embedded processors; signal processing basics; functional behavior.

Unit III
System architectures; integration challenges; hardware software interaction; performance metrics; design considerations.

Unit IV
Applications; communication, sensing, intelligent systems; industrial relevance; deployment considerations.

Unit V
Future trends; ethical considerations; sustainability; research directions; societal impact awareness.

Text Books

1. Saleh, B. E. A., & Teich, M. C. (2019). *Fundamentals of Photonics*. Wiley.
2. Murmann, B. (2020). *Embedded Machine Learning*. Springer.
3. Keiser, G. (2010). *Optical Fiber Communications*. McGraw-Hill.
4. Russell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach*. Pearson.
5. Sze, S. M. (2010). *Semiconductor Devices*. Wiley.

Reference Books

1. Agrawal, G. P. (2013). *Fiber-Optic Communication Systems*. Wiley.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
3. Datta, S. (2005). *Quantum Transport*. Cambridge.
4. Hennessy, J. L., & Patterson, D. A. (2017). *Computer Architecture*. Morgan Kaufmann.
5. Floridi, L. (2014). *The Ethics of Information*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

MINOR PROJECT II (FABRICATION / DESIGN PROJECT)

Course Category:
Project Course

Credits / Contact Hours:
5 Credits / 75 Contact Hours

Course Objectives

1. Advanced project execution capability
2. Semiconductor design or fabrication exposure
3. Research and implementation skills
4. Technical documentation proficiency
5. Preparation for major project

Course Outcomes

CO1: Define advanced project objectives
CO2: Apply design or fabrication techniques
CO3: Analyze project outcomes critically
CO4: Document technical results professionally
CO5: Present and defend project work

Guidelines

• Project selection in design or fabrication domain
• Faculty supervision with periodic reviews
• Use of industry standard tools or processes
• Comprehensive project report submission
• Demonstration and viva-voce evaluation

Evaluation Scheme

Continuous Assessment (100%)

VII SEMESTER — B.TECH. SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN (CREDITS 20)

SYSTEM-ON-CHIP (SOC) DESIGN

COURSE CATEGORY:
CORE ENGINEERING COURSE

CREDITS / CONTACT HOURS:
3 CREDITS / 45 CONTACT HOURS

Course Objectives

1. SoC architecture fundamentals understanding
2. IP-based design methodologies awareness
3. On-chip communication concepts
4. Integration and verification challenges knowledge
5. Preparation for complex chip-level projects

Course Outcomes

CO1: Explain SoC architecture and components
CO2: Analyze IP reuse and integration strategies
CO3: Understand on-chip interconnect mechanisms
CO4: Evaluate SoC design constraints
CO5: Relate SoC concepts to real applications

Detailed Syllabus

Unit I

System-on-Chip concepts; evolution from ASIC, SoC components; processors, memories, peripherals; integration levels; application domains; architectural relevance, complexity management.

Unit II

IP design and reuse; hard, soft, firm IPs; IP integration flow; reuse challenges; design productivity; verification implications, scalability considerations.

Unit III

On-chip communication; bus based systems; AMBA overview; network-on-chip concepts; arbitration schemes; bandwidth, latency considerations.

Unit IV

SoC design flow; specification, modeling; hardware software co-design; verification strategies; prototyping approaches; design closure relevance.

Unit V
Power management; clock management; low power techniques; DVFS concepts; SoC reliability; system-level optimization considerations.

Text Books

1. Wolf, W. (2010). *Modern SoC Design*. Morgan Kaufmann.
2. Flynn, D. (2010). *ARM System-on-Chip Architecture*. Pearson.
3. Keating, M., & Bricaud, P. (2002). *Reuse Methodology Manual*. Springer.
4. Jerraya, A. A., Wolf, W., & Martin, G. (2005). *Embedded Software for SoC*. Springer.
5. Dutt, N., & Choudhary, A. (2011). *System-Level Design*. Morgan Kaufmann.

Reference Books

1. Hennessy, J. L., & Patterson, D. A. (2017). *Computer Architecture*. Morgan Kaufmann.
2. Gajski, D. D. (2000). *Principles of Digital Design*. Prentice Hall.
3. Sangiovanni-Vincentelli, A. (2007). *Quo Vadis SLD*. Springer.
4. Bergeron, J. (2012). *Writing Testbenches*. Springer.
5. Rabaey, J. M. (2009). *Low Power Design Essentials*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMICONDUCTOR RELIABILITY & FAILURE ANALYSIS

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Reliability concepts in semiconductor devices
2. Failure mechanisms understanding
3. Testing and qualification methods knowledge
4. Reliability modeling awareness
5. Industry-oriented reliability perspective

Course Outcomes

CO1: Explain reliability metrics and models
CO2: Identify common failure mechanisms
CO3: Apply failure analysis techniques
CO4: Understand qualification standards
CO5: Relate reliability to product lifecycle

Detailed Syllabus

Unit I

Reliability fundamentals; failure rates; bathtub curve; MTTF concepts; reliability metrics; semiconductor product lifecycle relevance.

Unit II

Failure mechanisms; electromigration; time dependent dielectric breakdown; hot carrier effects; bias temperature instability; physical origins.

Unit III

Reliability testing; accelerated life testing; stress methods; temperature, voltage stress; data interpretation; qualification relevance.

Unit IV

Failure analysis techniques; optical microscopy; SEM; TEM basics; fault localization; root cause identification.

Unit V

Reliability standards; JEDEC, MIL standards; qualification flows; reliability improvement strategies; industrial practices.

Text Books

1. Pecht, M. (2009). *Reliability Engineering*. Wiley.
2. Schroder, D. K. (2006). *Semiconductor Material and Device Characterization*. Wiley.
3. Hu, C. (2010). *Modern Semiconductor Devices for Integrated Circuits*. Pearson.
4. Sze, S. M. (2010). *VLSI Technology*. McGraw-Hill.
5. Black, J. R. (2011). *Electromigration*. IEEE Press.

Reference Books

1. McPherson, J. W. (2013). *Reliability Physics and Engineering*. Springer.
2. Stathis, J. H. (2011). *Reliability of Semiconductor Devices*. Springer.
3. Nicollian, E. H., & Brews, J. R. (2003). *MOS Physics and Technology*. Wiley.
4. Geng, H. (2016). *Semiconductor Manufacturing Handbook*. McGraw-Hill.
5. Lau, J. H. (2010). *Flip Chip Technologies*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

PROFESSIONAL ELECTIVE II (AI ACCELERATORS / RF IC DESIGN)

Course Category:
Professional Elective Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Advanced specialization knowledge acquisition
2. Domain-specific circuit understanding
3. Performance-driven design awareness
4. Emerging technology relevance
5. Preparation for industry-oriented roles

Course Outcomes
CO1: Explain principles of selected specialization
CO2: Analyze specialized circuit architectures
CO3: Evaluate performance trade-offs
CO4: Understand implementation challenges
CO5: Relate specialization to semiconductor applications

Detailed Syllabus

Unit I
AI accelerator or RF IC overview; application domains; performance metrics; technology drivers; system-level relevance.

Unit II
Architectures; dataflow models or RF front ends; core blocks; design constraints; functional analysis.

Unit III
Circuit level considerations; power efficiency; noise, linearity; scaling effects; design trade-offs.

Unit IV
Fabrication and integration aspects; process technology; packaging implications; reliability considerations.

Unit V
Case studies; industrial implementations; emerging trends; challenges; future scope.

Text Books

1. Sze, V., Chen, Y. H., Yang, T. J., & Emer, J. S. (2017). *Efficient Processing of Deep Neural Networks*. Morgan Kaufmann.
2. Razavi, B. (2012). *RF Microelectronics*. Prentice Hall.
3. Flynn, D. (2010). *ARM System-on-Chip Architecture*. Pearson.
4. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic Circuits*. Oxford.
5. Rabaey, J. M. (2009). *Low Power Design Essentials*. Springer.

Reference Books

1. Murmann, B. (2020). *Embedded Machine Learning*. Springer.
2. Lee, T. H. (2004). *The Design of CMOS RF Integrated Circuits*. Cambridge.
3. Chandrakasan, A. (2011). *Design of High-Performance Microprocessor Circuits*. IEEE.
4. Wolf, W. (2008). *Modern VLSI Design*. Pearson.
5. Datta, S. (2005). *Quantum Transport*. Cambridge.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

PROFESSIONAL ELECTIVE III (AUTOMOTIVE ELECTRONICS / QUANTUM DEVICES)

Course Category:
Professional Elective Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Advanced interdisciplinary specialization exposure
2. Device and system-level understanding
3. Technology convergence awareness
4. Application-driven learning
5. Preparation for emerging industry sectors

Course Outcomes
CO1: Explain principles of selected elective domain
CO2: Analyze device or system architectures

CO3: Evaluate application requirements
CO4: Understand technological challenges
CO5: Relate elective domain to semiconductor engineering

Detailed Syllabus

Unit I
Automotive electronics or quantum devices overview; application areas; performance requirements; industry drivers.

Unit II
System architectures; power electronics, control units or quantum structures; functional behavior analysis.

Unit III
Device technologies; sensors, actuators or quantum materials; fabrication considerations; reliability aspects.

Unit IV
Integration challenges; safety standards or coherence issues; packaging relevance; testing considerations.

Unit V
Future trends; autonomous systems or quantum computing prospects; research directions; societal impact.

Text Books

1. Ribbens, W. B. (2017). *Understanding Automotive Electronics*. Butterworth-Heinemann.
2. Nielsen, M. A., & Chuang, I. L. (2010). *Quantum Computation and Quantum Information*. Cambridge.
3. Baliga, B. J. (2010). *Fundamentals of Power Semiconductor Devices*. Springer.
4. Datta, S. (2005). *Quantum Transport*. Cambridge.
5. Sze, S. M. (2010). *VLSI Technology*. McGraw-Hill.

Reference Books

1. Bosch. (2018). *Automotive Handbook*. Wiley.
2. Wolf, E. L. (2012). *Nanophysics and Nanotechnology*. Wiley.
3. Hu, C. (2010). *Modern Semiconductor Devices*. Pearson.
4. Devoret, M. H. (2013). *Quantum Information Processing*. Springer.
5. Taur, Y., & Ning, T. H. (2013). *Fundamentals of Modern VLSI Devices*. Cambridge.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

EMERGING TRENDS IN SEMICONDUCTOR TECHNOLOGY

Course Category:
Core Engineering Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Awareness of latest semiconductor advancements
2. Technology roadmap understanding
3. Interdisciplinary convergence insight
4. Research orientation development
5. Industry readiness enhancement

Course Outcomes
CO1: Identify emerging semiconductor technologies
CO2: Analyze technology trends and roadmaps
CO3: Understand interdisciplinary impacts
CO4: Evaluate societal and industrial implications
CO5: Relate trends to future career pathways

Detailed Syllabus

Unit I
Semiconductor industry roadmap; scaling trends; beyond CMOS concepts; technology drivers; global ecosystem relevance.

Unit II
Advanced materials; wide bandgap semiconductors; GaN, SiC; applications; performance advantages.

Unit III
Heterogeneous integration; chiplets; 2.5D, 3D ICs; advanced packaging; system performance relevance.

Unit IV
AI hardware; neuromorphic computing; in-memory computing; hardware acceleration trends; efficiency focus.

Unit V
Sustainability and ethics; green manufacturing; supply chain resilience; policy impact; future outlook.

Text Books

1. Taur, Y., & Ning, T. H. (2013). *Fundamentals of Modern VLSI Devices*. Cambridge.
2. Sze, S. M., & Ng, K. K. (2006). *Physics of Semiconductor Devices*. Wiley.
3. Lundstrom, M. (2017). *Fundamentals of Nanotransistors*. World Scientific.
4. Wolf, W. (2008). *Modern VLSI Design*. Pearson.
5. Hu, C. (2010). *Modern Semiconductor Devices*. Pearson.

Reference Books

1. ITRS Reports. (2016). *International Technology Roadmap for Semiconductors*.
2. Wong, H. S. P. (2014). *Nano-CMOS Circuit and Physical Design*. Wiley.
3. Baliga, B. J. (2010). *Fundamentals of Power Semiconductor Devices*. Springer.
4. Floridi, L. (2014). *The Ethics of Information*. Oxford.
5. Geng, H. (2016). *Semiconductor Manufacturing Handbook*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMESTER INTERNSHIP (INDUSTRY / RESEARCH LAB)

Course Category:
Internship / Industrial Training Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Full-semester industrial or research exposure
2. Application of advanced semiconductor knowledge
3. Professional competency enhancement
4. Research and development experience
5. Industry–academia integration

Course Outcomes
CO1: Apply advanced concepts in real environments

CO2: Demonstrate professional discipline
CO3: Solve practical engineering problems
CO4: Document industrial or research work
CO5: Present experiential learning effectively

Guidelines
• Internship in approved industry or research laboratory
• Continuous supervision by internal and external mentors
• Periodic progress reviews and reporting
• Submission of comprehensive internship report
• Presentation and evaluation by institute committee

Evaluation Scheme
Continuous Assessment (100%)

MAJOR PROJECT PHASE I

Course Category:
Project Course

Credits / Contact Hours:
1 Credit / 15 Contact Hours

Course Objectives

1. Major project problem identification
2. Literature survey competence
3. Project planning and methodology formulation
4. Team coordination skills
5. Preparation for execution phase

Course Outcomes
CO1: Define major project objectives
CO2: Conduct comprehensive literature survey
CO3: Develop project methodology and plan
CO4: Demonstrate teamwork and communication
CO5: Present project proposal effectively

Guidelines
• Identification of project topic in semiconductor domain
• Detailed literature review and problem formulation
• Project proposal submission and approval
• Periodic reviews and presentations
• Evaluation through proposal and review performance

Evaluation Scheme
Continuous Assessment (100%)

VIII SEMESTER — B.TECH. SEMICONDUCTOR TECHNOLOGY & CHIP DESIGN (CREDITS 20)

Intellectual Property Rights & Technology Entrepreneurship

Course Category:
Humanities & Management Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Intellectual property fundamentals understanding
2. Legal protection mechanisms awareness
3. Technology commercialization knowledge
4. Innovation and startup ecosystem exposure
5. Professional and ethical responsibility development

Course Outcomes
CO1: Explain different forms of intellectual property
CO2: Understand patent filing and examination process
CO3: Analyze IP management strategies
CO4: Relate IP concepts to technology entrepreneurship
CO5: Apply legal and ethical considerations in innovation

Detailed Syllabus

Unit I
Intellectual property concepts; patents, copyrights, trademarks; industrial designs; geographical indications; economic significance; innovation incentives; global IP framework, technology driven competitiveness, knowledge economy relevance.

Unit II
Patent law fundamentals; patentability criteria; novelty, inventive step; prior art search; patent drafting structure; filing procedures; examination stages; grant processes; jurisdictional considerations.

Unit III
Copyrights and trademarks; scope, registration process; infringement issues; licensing agreements; brand protection; software and digital content relevance; enforcement mechanisms.

Unit IV
Technology transfer; commercialization pathways; licensing models; valuation of intellectual

property; startup incubation; venture capital basics; industry academia collaboration relevance.

Unit V
Entrepreneurship ecosystem; startup lifecycle; business models; innovation management; ethics, regulatory compliance; societal impact; sustainable technology enterprises.

Text Books

1. WIPO. (2016). *Intellectual Property Handbook*. WIPO Publications.
2. Narayanan, P. (2017). *Intellectual Property Law*. Eastern Book Company.
3. Bansal, A., & Bansal, S. (2019). *Intellectual Property Rights*. Pearson.
4. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). *Entrepreneurship*. McGraw-Hill.
5. Timmons, J. A., & Spinelli, S. (2014). *New Venture Creation*. McGraw-Hill.

Reference Books

1. Cornish, W., Llewelyn, D., & Aplin, T. (2019). *Intellectual Property*. Sweet & Maxwell.
2. Kitch, E. W. (2000). *The Nature and Function of the Patent System*. University of Chicago Press.
3. Drucker, P. F. (2007). *Innovation and Entrepreneurship*. Butterworth-Heinemann.
4. Ries, E. (2011). *The Lean Startup*. Crown.
5. OECD. (2015). *Innovation Policies for the 21st Century*. OECD.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

MAJOR PROJECT PHASE II (INDUSTRY / RESEARCH BASED)

Course Category:
Project Course

Credits / Contact Hours:
10 Credits / 150 Contact Hours

Course Objectives

1. Independent problem solving capability
2. Application of semiconductor engineering knowledge
3. Research or industry oriented implementation

4. Technical documentation proficiency
5. Professional presentation and defense skills

Course Outcomes
CO1: Implement major project objectives effectively
CO2: Apply advanced tools and methodologies
CO3: Analyze results critically and systematically
CO4: Prepare comprehensive technical documentation
CO5: Defend project work professionally

Guidelines
• Execution of approved major project topic
• Industry or research laboratory collaboration encouraged
• Regular progress reviews by project supervisor
• Submission of dissertation and technical artifacts
• Final evaluation through presentation and viva-voce

Evaluation Scheme
Continuous Assessment (100%)

OPEN ELECTIVE III (INTERDISCIPLINARY)

Course Category:
Open Elective Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Interdisciplinary knowledge integration
2. Exposure to non-core engineering domains
3. Broadened problem solving perspective
4. Awareness of societal and technological interfaces
5. Holistic engineering education enhancement

Course Outcomes
CO1: Understand fundamentals of selected interdisciplinary area
CO2: Analyze cross-domain applications
CO3: Apply basic concepts in problem contexts
CO4: Evaluate societal and ethical implications
CO5: Integrate interdisciplinary knowledge with core domain

Detailed Syllabus

Unit I
Interdisciplinary overview; technology convergence; engineering interfaces with science, management, humanities; problem context identification; relevance to modern engineering practice.

Unit II
Fundamental concepts of chosen domain; core principles; terminology; basic models; analytical perspectives; application orientation.

Unit III
Tools and techniques; data, systems, methods; cross disciplinary problem solving approaches; integration challenges; practical relevance.

Unit IV
Application case studies; industry examples; societal impact; sustainability considerations; regulatory aspects; interdisciplinary effectiveness.

Unit V
Future scope; emerging interdisciplinary fields; innovation opportunities; ethical responsibilities; global trends; lifelong learning relevance.

Text Books

1. Klein, J. T. (2017). *Interdisciplinarity*. Wayne State University Press.
2. Repko, A. F., & Szostak, R. (2020). *Interdisciplinary Research*. Sage.
3. Rogers, E. M. (2010). *Diffusion of Innovations*. Free Press.
4. Floridi, L. (2014). *The Ethics of Information*. Oxford.
5. OECD. (2018). *The Future of Education and Skills*. OECD.

Reference Books

1. Newell, W. H. (2013). *Interdisciplinarity*. Oxford.
2. Checkland, P. (2000). *Systems Thinking*. Wiley.
3. Snowden, D., & Boone, M. (2007). *A Leader's Framework for Decision Making*. Harvard.
4. Drucker, P. F. (2007). *Management Challenges*. Harper.
5. UNESCO. (2015). *Rethinking Education*. UNESCO.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

SEMINAR / VIVA-VOCE / PORTFOLIO

Course Category:
Project Course

Credits / Contact Hours:
3 Credits / 45 Contact Hours

Course Objectives

1. Technical communication skill enhancement
2. Literature survey and synthesis ability
3. Professional presentation competence
4. Critical questioning and defense skills
5. Career readiness and confidence building

Course Outcomes
CO1: Conduct structured literature review
CO2: Prepare technical seminar presentation
CO3: Communicate ideas effectively
CO4: Respond to technical queries confidently
CO5: Compile professional academic portfolio

Guidelines
• Seminar topic related to semiconductor technology or allied areas
• Literature survey using reputed journals and databases
• Structured seminar presentation with visual aids
• Viva-voce examination by internal and external experts
• Portfolio submission including projects, internships, achievements

Evaluation Scheme
Continuous Assessment (100%)

M.TECH. EMBEDDED SYSTEMS FOR AUTOMOTIVE & DEFENCE ELECTRONICS

Duration: 2Years | 4 Semesters | Total Credits: 80

I SEMESTER – M.TECH. EMBEDDED SYSTEMS FOR AUTOMOTIVE & DEFENCE ELECTRONICS (CREDITS 20)

ADVANCED ENGINEERING MATHEMATICS

Course Category:
Basic Science Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Strengthen mathematical foundations for advanced embedded system analysis
2. Develop competence in linear algebra and transform techniques
3. Apply probability and stochastic methods to engineering systems
4. Enable mathematical modeling of dynamic systems
5. Support research-oriented problem solving in engineering domains

Course Outcomes

CO1 Apply advanced calculus methods to engineering problems
CO2 Analyze systems using linear algebra and matrix theory
CO3 Utilize transforms for system modeling and signal analysis
CO4 Apply probability concepts to uncertainty modeling
CO5 Formulate mathematical solutions for research problems

Detailed Syllabus

Unit I
Functions of several variables, partial differentiation, total derivatives; Jacobians, Taylor series expansion; extrema of multivariable functions; Lagrange multipliers, constrained optimization; engineering applications, system sensitivity analysis, multivariable modeling, embedded system performance optimization.

Unit II
Linear algebra concepts, vector spaces, linear independence, basis, dimension; eigenvalues, eigenvectors; diagonalization, Cayley Hamilton theorem; quadratic forms, positive

definiteness; matrix decomposition techniques, state space representation, embedded control system analysis.

Unit III

Ordinary differential equations, higher order linear equations; complementary function, particular integral; systems of differential equations; Laplace transforms, inverse transforms; convolution theorem; solution of initial value problems, dynamic system response, transient analysis.

Unit IV

Fourier series, half range expansions; Fourier transforms, properties; Z transforms, inverse Z transform; discrete time system analysis; stability criteria; frequency domain representation, digital signal processing foundations, embedded signal analysis.

Unit V

Probability theory, random variables, probability distributions; expectation, variance; joint distributions, correlation, covariance; stochastic processes, Markov chains; reliability analysis, noise modeling, uncertainty quantification in embedded and automotive systems.

Text Books

1. Kreyszig, E. (2011). *Advanced engineering mathematics* (10th ed.). Wiley.
2. Erwin, K. (2015). *Advanced engineering mathematics*. Wiley India.
3. Zill, D. G., & Cullen, M. R. (2009). *Advanced engineering mathematics*. Jones & Bartlett.
4. Jain, R. K., & Iyengar, S. R. K. (2014). *Advanced engineering mathematics*. Narosa.
5. Bapat, R. B. (2010). *Linear algebra and linear models*. Springer.

Reference Books

1. Strang, G. (2016). *Introduction to linear algebra* (5th ed.). Wellesley Cambridge Press.
2. Papoulis, A., & Pillai, S. U. (2002). *Probability, random variables and stochastic processes*. McGraw-Hill.
3. Boylestad, R. L. (2015). *Introductory circuit analysis*. Pearson.
4. Oppenheim, A. V., & Schafer, R. W. (2010). *Signals and systems*. Pearson.
5. Arfken, G. B., Weber, H. J., & Harris, F. E. (2013). *Mathematical methods for physicists*. Elsevier.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

EMBEDDED SYSTEMS ARCHITECTURE & DESIGN

Course Category:
Core Engineering Course

Credits / Contact Hours:
4 Credits / 60 Contact Hours

Course Objectives

1. Understand embedded system architectural principles
2. Analyze hardware software co design methodologies
3. Design scalable embedded architectures
4. Integrate peripherals and communication interfaces
5. Enable system level optimization for automotive and defence applications

Course Outcomes

CO1 Analyze embedded system architectural components
CO2 Design hardware software partitioned systems
CO3 Evaluate processor and memory architectures
CO4 Integrate peripheral subsystems effectively
CO5 Optimize embedded system performance

Detailed Syllabus

Unit I
Embedded system overview, classification, design metrics; processor architectures, Harvard, Von Neumann; RISC, CISC concepts; instruction pipelines, execution models; embedded computing constraints, automotive and defence application requirements.

Unit II
Hardware software co design principles; system specification, modeling techniques; design flow, partitioning strategies; concurrency, scheduling; design validation, performance metrics, power constraints, reliability considerations in embedded platforms.

Unit III
Memory architecture, ROM, RAM, cache hierarchy; address mapping; memory interfacing; bus architectures, AMBA, AHB, APB; arbitration techniques; throughput optimization, real time data access, embedded system scalability.

Unit IV
Peripheral interfacing concepts; timers, counters, ADC, DAC; GPIO, interrupts, DMA controllers; serial interfaces; system integration challenges; latency analysis, deterministic behavior, embedded I O subsystem design.

Unit V

Embedded system optimization; power management techniques; clock management; low power design; reliability, fault tolerance; design for automotive and defence standards; case studies, architectural trade off analysis.

Text Books

1. Vahid, F., & Givargis, T. (2016). *Embedded system design*. Wiley.
2. Noergaard, T. (2012). *Embedded systems architecture*. Newnes.
3. Gajski, D. D., Abdi, S., Gerstlauer, A., & Schirner, G. (2009). *Embedded system design*. Springer.
4. Wolf, W. (2012). *Computers as components*. Morgan Kaufmann.
5. Barr, M., & Massa, A. (2006). *Programming embedded systems*. O'Reilly.

Reference Books

1. Hennessy, J. L., & Patterson, D. A. (2017). *Computer architecture*. Morgan Kaufmann.
2. Tanenbaum, A. S. (2016). *Structured computer organization*. Pearson.
3. Laplante, P. A. (2017). *Real time systems design and analysis*. Wiley.
4. Heath, S. (2003). *Embedded systems design*. Elsevier.
5. Zurawski, R. (2014). *Embedded systems handbook*. CRC Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

ADVANCED DIGITAL SYSTEM DESIGN

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Strengthen digital system design fundamentals
2. Apply hardware description languages effectively
3. Design synchronous and asynchronous systems
4. Analyze timing and performance constraints

5. Enable complex digital subsystem implementation

Course Outcomes

CO1 Design advanced combinational and sequential circuits
CO2 Apply HDL based modeling techniques
CO3 Analyze timing and synchronization issues
CO4 Implement optimized digital architectures
CO5 Validate digital systems for reliability

Detailed Syllabus

Unit I
Boolean algebra review, logic minimization; combinational circuit design; arithmetic circuits, adders, multipliers; comparators; code converters; performance metrics, propagation delay, power dissipation, digital design optimization.

Unit II
Sequential logic design; latches, flip flops; registers, counters; finite state machines; state minimization; synchronous design principles; clocking strategies, metastability, reliable state transition modeling.

Unit III
Timing analysis, setup and hold constraints; clock skew, jitter; synchronous system design; asynchronous system fundamentals; handshake protocols; hazard analysis; timing closure techniques, high speed digital systems.

Unit IV
Hardware description languages; Verilog constructs; behavioral, dataflow, structural modeling; test benches; simulation techniques; synthesis concepts; design verification, functional coverage, hardware validation workflows.

Unit V
Digital system implementation; FPGA architectures; logic blocks, routing; design flow; constraints specification; optimization techniques; low power digital design; embedded digital subsystem case studies.

Text Books

1. Wakerly, J. F. (2018). *Digital design* (5th ed.). Pearson.
2. Palnitkar, S. (2015). *Verilog HDL*. Pearson.
3. Roth, C. H., & Kinney, L. L. (2013). *Fundamentals of logic design*. Cengage.
4. Brown, S., & Vranesic, Z. (2014). *Fundamentals of digital logic*. McGraw-Hill.
5. Ashenden, P. J. (2010). *Digital design*. Morgan Kaufmann.

Reference Books

1. Harris, D., & Harris, S. (2013). *Digital design and computer architecture*. Morgan Kaufmann.
2. Mano, M. M., & Ciletti, M. D. (2017). *Digital design*. Pearson.
3. Katz, R. H., & Borriello, G. (2004). *Contemporary logic design*. Pearson.
4. Wolf, W. (2008). *FPGA based system design*. Prentice Hall.
5. Chu, P. P. (2008). *RTL hardware design using VHDL*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

REAL-TIME OPERATING SYSTEMS

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand real time system concepts
2. Analyze scheduling and task management
3. Apply RTOS mechanisms in embedded systems
4. Evaluate timing constraints and predictability
5. Support automotive and defence real time applications

Course Outcomes

CO1 Explain real time system characteristics
CO2 Apply scheduling algorithms effectively
CO3 Design RTOS based embedded applications
CO4 Analyze timing and resource constraints
CO5 Validate real time system performance

Detailed Syllabus

Unit I
Real time system concepts; hard, firm, soft deadlines; task models; timing constraints; performance metrics; predictability requirements; embedded application domains, automotive and defence real time scenarios.

Unit II
Scheduling algorithms; rate monotonic, earliest deadline first; priority assignment;

schedulability analysis; context switching; task synchronization; real time kernel fundamentals, latency considerations.

Unit III
Inter task communication; semaphores, mutexes, message queues; deadlock, priority inversion; resource sharing protocols; real time IPC mechanisms; deterministic behavior, concurrency control.

Unit IV
Memory management in RTOS; static, dynamic allocation; real time file systems; device drivers; interrupt handling; timer management; kernel services, reliability and fault tolerance.

Unit V
RTOS case studies; FreeRTOS, VxWorks overview; automotive RTOS requirements; safety considerations; certification aspects; performance evaluation; real time application development workflow.

Text Books

1. Liu, J. W. S. (2000). *Real time systems*. Prentice Hall.
2. Laplante, P. A. (2017). *Real time systems design and analysis*. Wiley.
3. Jane W. S. Liu. (2000). *Real time systems*. Pearson.
4. Katcher, D. I., Arakawa, H., & Strosnider, J. K. (1993). *Engineering real time systems*. IEEE.
5. Stallings, W. (2018). *Operating systems*. Pearson.

Reference Books

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2018). *Operating system concepts*. Wiley.
2. Burns, A., & Wellings, A. (2009). *Real time systems and programming languages*. Pearson.
3. Tanenbaum, A. S., & Bos, H. (2015). *Modern operating systems*. Pearson.
4. Labrosse, J. J. (2011). *MicroC OS II*. Elsevier.
5. Barry, R. (2016). *Mastering the FreeRTOS real time kernel*. Real Time Engineers.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

AUTOMOTIVE ELECTRONICS FUNDAMENTALS

COURSE CATEGORY
AUTOMOTIVE & DEFENCE SPECIALIZATION COURSE

CREDITS / CONTACT HOURS
3 CREDITS / 45 CONTACT HOURS

Course Objectives

1. Understand automotive electronic subsystems
2. Analyze vehicle electrical architectures
3. Study sensors and actuators in vehicles
4. Apply electronics to automotive control systems
5. Prepare for advanced automotive embedded applications

Course Outcomes

CO1 Identify automotive electronic architectures
CO2 Analyze sensor and actuator interfaces
CO3 Understand vehicle control subsystems
CO4 Apply electronics in automotive applications
CO5 Evaluate automotive system requirements

Detailed Syllabus

Unit I
Automotive electrical architecture; vehicle power distribution; wiring harnesses; grounding; electromagnetic compatibility; standards overview; automotive environmental constraints, reliability requirements, electronic integration challenges.

Unit II
Sensors in automotive systems; position, speed, temperature, pressure sensors; signal conditioning; actuators; motors, solenoids; interface circuits; calibration, accuracy, robustness considerations.

Unit III
Engine management systems; fuel injection control; ignition systems; emission control; electronic control units; closed loop control; performance optimization, diagnostics, regulatory compliance.

Unit IV
Chassis electronics; braking systems, ABS, traction control; steering systems; suspension control; safety considerations; redundancy, fault detection, electronic stability mechanisms.

Unit V

Body electronics; lighting, infotainment; comfort systems; diagnostics; onboard monitoring; automotive networking basics; future trends, electrification, autonomous system foundations.

Text Books

1. Denton, T. (2017). *Automobile electrical and electronic systems*. Routledge.
2. Ribbens, W. B. (2012). *Understanding automotive electronics*. Butterworth-Heinemann.
3. Bosch. (2018). *Automotive handbook*. Wiley.
4. Reif, K. (2015). *Automotive mechatronics*. Springer.
5. Heisler, H. (2002). *Advanced vehicle technology*. Butterworth-Heinemann.

Reference Books

1. Jack Erjavec. (2013). *Automotive technology*. Cengage.
2. Tom Denton. (2016). *Advanced automotive fault diagnosis*. Routledge.
3. Larminie, J., & Lowry, J. (2012). *Electric vehicle technology*. Wiley.
4. Pyle, A. (2014). *Automotive sensors*. Elsevier.
5. Guzzella, L., & Sciarretta, A. (2013). *Vehicle propulsion systems*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

RESEARCH METHODOLOGY & TECHNICAL WRITING

Course Category
Humanities & Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Develop research problem identification skills
2. Understand research design and methodology
3. Apply statistical and analytical tools
4. Improve technical writing and presentation
5. Support postgraduate research activities

Course Outcomes

CO1 Identify and formulate research problems
CO2 Apply appropriate research methodologies
CO3 Analyze research data systematically
CO4 Prepare technical reports and papers
CO5 Demonstrate ethical research practices

Detailed Syllabus

Unit I
Research fundamentals; types of research; problem identification; literature survey techniques; research gaps; hypothesis formulation; objectives definition; academic integrity, plagiarism awareness.

Unit II
Research design; qualitative, quantitative methods; experimental design; data collection techniques; sampling methods; measurement scales; validity, reliability considerations.

Unit III
Statistical analysis; descriptive statistics; probability concepts; inferential statistics; regression analysis; hypothesis testing; interpretation of results; research data visualization.

Unit IV
Technical writing principles; structure of research papers; thesis organization; citation styles; reference management; graphical presentation; clarity, conciseness, academic writing standards.

Unit V
Research ethics; intellectual property; patents; copyrights; peer review process; publication ethics; funding proposals; project management fundamentals.

Text Books

1. Kothari, C. R. (2014). *Research methodology*. New Age.
2. Creswell, J. W. (2014). *Research design*. Sage.
3. Booth, W. C., Colomb, G. G., & Williams, J. M. (2016). *The craft of research*. University of Chicago Press.
4. Day, R. A., & Gastel, B. (2012). *How to write and publish a scientific paper*. Cambridge University Press.
5. Zobel, J. (2015). *Writing for computer science*. Springer.

Reference Books

1. Alley, M. (2013). *The craft of scientific writing*. Springer.
2. Turabian, K. L. (2018). *A manual for writers*. University of Chicago Press.
3. IEEE. (2023). *IEEE editorial style manual*. IEEE.

4. Ethics Committee, COPE. (2019). *Publication ethics*. COPE.
5. Lipson, C. (2011). *Doing honest work in college*. University of Chicago Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

INDUSTRY ORIENTATION / LABORATORY PRACTICE

Course Category
Engineering Science Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Familiarize students with industry practices
2. Develop hands on exposure to embedded tools
3. Understand safety and professional practices
4. Bridge academic learning with industry needs
5. Enhance practical engineering skills

Course Outcomes

CO1 Demonstrate awareness of industry environments
CO2 Apply basic laboratory practices
CO3 Use embedded development tools
CO4 Follow safety and professional standards
CO5 Relate theory to industrial applications

List of Experiments / Exercises

1. Familiarization with embedded development laboratory, identification of hardware platforms, safety procedures, industry standard practices, professional conduct expectations.
2. Study of embedded development boards, processor features, pin configurations, power requirements, datasheet interpretation skills.
3. Installation and configuration of embedded IDEs, toolchains, compilers, debuggers, version control practices.
4. Hands on exploration of basic peripheral interfaces, GPIO operation, timing measurements, signal observation using tools.

5. Introduction to debugging techniques, breakpoints, watch variables, fault identification, troubleshooting methodologies.
6. Exposure to industry grade documentation, standards, coding guidelines, version control workflows.
7. Mini exercise on embedded system assembly, power up sequencing, basic functional validation.
8. Observation of automotive or defence embedded subsystems through demonstrations, videos, case artifacts.
9. Safety compliance exercise, ESD precautions, lab discipline, risk assessment awareness.
10. Industry interaction session, expert lecture, professional ethics, career orientation discussion.

Expected Outcomes

Improved industry readiness, practical tool familiarity, safety awareness, professional skill development, alignment of academic knowledge with embedded industry requirements.

Evaluation Scheme

Continuous Assessment (100%)

II SEMESTER – M.TECH. EMBEDDED SYSTEMS FOR AUTOMOTIVE & DEFENCE ELECTRONICS

ADVANCED MICROCONTROLLERS & PROCESSORS

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Develop in depth understanding of advanced microcontroller architectures
2. Analyze processor cores used in automotive and defence systems
3. Interface on chip peripherals and external devices
4. Optimize processor based system performance
5. Enable selection of processors for application specific designs

Course Outcomes

CO1 Analyze advanced microcontroller and processor architectures
CO2 Configure on chip peripherals and memory systems
CO3 Interface processors with external hardware components
CO4 Evaluate performance, power, and reliability trade offs
CO5 Apply processors effectively in automotive and defence systems

Detailed Syllabus

Unit I
Advanced microcontroller architecture; ARM Cortex M and A profiles; instruction set architecture; pipeline structures; execution modes; exception handling; performance metrics, embedded processor selection criteria, automotive and defence processing requirements.

Unit II
Memory systems; flash, SRAM, cache hierarchy; memory mapping; address decoding; memory protection units; boot mechanisms; startup sequences; deterministic memory access, reliability considerations in embedded processors.

Unit III
On chip peripherals; timers, PWM modules; ADC, DAC; communication controllers; interrupt controllers; DMA engines; peripheral configuration strategies, latency management, real time responsiveness.

Unit IV
External interfacing; memory expansion; external buses; parallel and serial interfaces; high

speed interfaces; signal integrity issues; board level considerations; processor pin multiplexing, hardware integration challenges.

Unit V
Processor performance optimization; low power modes; clock scaling; power domains; multicore concepts; benchmarking techniques; processor selection case studies for automotive and defence embedded systems.

Text Books

1. Yiu, J. (2019). *The definitive guide to ARM Cortex M processors*. Newnes.
2. Sloss, A., Symes, D., & Wright, C. (2004). *ARM system developer's guide*. Morgan Kaufmann.
3. Valvano, J. (2018). *Embedded systems*. Cengage.
4. Furber, S. (2020). *ARM system on chip architecture*. Pearson.
5. Ganssle, J. (2014). *The art of designing embedded systems*. Newnes.

Reference Books

1. Hennessy, J. L., & Patterson, D. A. (2017). *Computer architecture*. Morgan Kaufmann.
2. Mazidi, M. A., Naimi, S., & Naimi, S. (2018). *ARM assembly language programming*. MicroDigitalEd.
3. Barrett, S., & Pack, D. (2012). *Embedded systems design*. Pearson.
4. Wolf, W. (2012). *Computers as components*. Morgan Kaufmann.
5. Noergaard, T. (2012). *Embedded systems architecture*. Newnes.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

AUTOMOTIVE COMMUNICATION PROTOCOLS (CAN, LIN, FLEXRAY)

Course Category
Automotive & Defence Specialization Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand in vehicle networking requirements
2. Analyze automotive communication protocols

3. Design networked automotive embedded systems
4. Evaluate protocol performance and reliability
5. Support diagnostics and fault tolerant communication

Course Outcomes

CO1 Explain automotive networking architectures
CO2 Analyze CAN, LIN, and FlexRay protocols
CO3 Design in vehicle communication systems
CO4 Evaluate timing and reliability constraints
CO5 Apply protocols in automotive applications

Detailed Syllabus

Unit I
In vehicle networking concepts; distributed automotive systems; network topologies; communication requirements; real time constraints; fault tolerance; automotive network evolution, integration challenges.

Unit II
Controller Area Network fundamentals; frame structure; arbitration; bit timing; error detection; fault confinement; CAN data rate limitations, reliability features, automotive ECU communication.

Unit III
Local Interconnect Network protocol; master slave architecture; scheduling; frame structure; synchronization; error handling; low cost body electronics communication, scalability considerations.

Unit IV
FlexRay protocol architecture; static and dynamic segments; time triggered communication; synchronization; fault tolerance mechanisms; high speed deterministic networking for safety critical systems.

Unit V
Automotive diagnostics; OBD concepts; UDS services; gateway design; network management; security considerations; protocol comparison, design trade off analysis.

Text Books

1. Navet, N., & Simonot Lion, F. (2009). *Automotive embedded systems handbook*. CRC Press.
2. Paret, D. (2007). *Multiplexed networks for embedded systems*. Wiley.
3. Bosch. (2011). *CAN specification*. Bosch.
4. FlexRay Consortium. (2010). *FlexRay protocol specification*. FlexRay Consortium.

5. Zimmermann, W., & Schmidgall, R. (2015). *Bus systems in the automobile*. Wiley.

Reference Books

1. Ribbens, W. B. (2012). *Understanding automotive electronics*. Butterworth-Heinemann.
2. Reif, K. (2015). *Automotive mechatronics*. Springer.
3. Wilwert, C. (2008). *Automotive networks*. SAE.
4. ISO. (2018). *ISO 11898 road vehicles CAN*. ISO.
5. SAE. (2016). *Vehicle network standards*. SAE.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

DEFENCE ELECTRONICS SYSTEMS & STANDARDS

Course Category
Automotive & Defence Specialization Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand defence electronic system architectures
2. Study military communication and sensor systems
3. Analyze defence electronics standards
4. Apply reliability and ruggedization principles
5. Prepare for defence embedded system development

Course Outcomes

CO1 Identify major defence electronic systems
CO2 Analyze defence communication architectures
CO3 Apply military standards and specifications
CO4 Evaluate reliability and environmental constraints
CO5 Design defence compliant embedded subsystems

Detailed Syllabus

Unit I
Overview of defence electronics; land, air, naval systems; command control systems;

surveillance architectures; mission requirements; integration challenges, system interoperability.

Unit II
Radar and electronic warfare basics; radar subsystems; signal processing chains; electronic countermeasures; communication intelligence; embedded processing requirements.

Unit III
Defence communication systems; secure communication; tactical data links; satellite communication basics; network centric warfare concepts; latency and reliability constraints.

Unit IV
Military standards; MIL STD specifications; environmental testing; EMI EMC requirements; ruggedization techniques; qualification processes; defence certification workflows.

Unit V
Reliability engineering; redundancy; fault tolerance; maintainability; life cycle considerations; defence electronics case studies, system level analysis.

Text Books

1. Moorthy, K. (2016). *Defence electronics*. DRDO Press.
2. Skolnik, M. I. (2008). *Radar handbook*. McGraw-Hill.
3. Schleher, D. C. (1999). *Electronic warfare*. Artech House.
4. Elbert, B. R. (2008). *Introduction to satellite communication*. Artech House.
5. Pecht, M. (2009). *Reliability engineering*. Wiley.

Reference Books

1. IEEE. (2020). *Military electronics standards handbook*. IEEE.
2. NATO. (2017). *Defence communication standards*. NATO.
3. Blanchard, B. S., & Fabrycky, W. J. (2011). *Systems engineering*. Pearson.
4. MIL STD 810. (2019). *Environmental engineering considerations*. DoD.
5. MIL STD 461. (2015). *EMI EMC requirements*. DoD.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

EMBEDDED SOFTWARE DEVELOPMENT

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop structured embedded software design skills
2. Apply programming techniques for embedded systems
3. Understand middleware and drivers
4. Implement reliable and maintainable code
5. Support safety critical software development

Course Outcomes

CO1 Develop embedded software architectures
CO2 Implement device drivers and middleware
CO3 Apply coding standards and best practices
CO4 Analyze software performance and reliability
CO5 Develop safety aware embedded software

Detailed Syllabus

Unit I
Embedded software architecture; layered models; bare metal programming; startup code; linker scripts; memory sections; software initialization, execution flow control.

Unit II
Embedded C programming; data types; pointers; bit manipulation; interrupt service routines; memory management; coding efficiency, determinism, reliability considerations.

Unit III
Device drivers; peripheral abstraction; polling, interrupt, DMA based drivers; middleware concepts; portability; hardware abstraction layers, modular software design.

Unit IV
Embedded software testing; debugging techniques; unit testing; integration testing; static analysis; code coverage; fault injection, software validation strategies.

Unit V
Safety critical software; MISRA C guidelines; software documentation; version control; configuration management; automotive and defence software case studies.

Text Books

1. Barr, M., & Massa, A. (2006). *Programming embedded systems*. O'Reilly.
2. Pont, M. J. (2001). *Patterns for time triggered embedded systems*. Addison Wesley.
3. Labrosse, J. J. (2011). *MicroC OS II*. Elsevier.
4. Koopman, P. (2010). *Better embedded system software*. Carnegie Mellon.
5. Ganssle, J. (2014). *The art of designing embedded systems*. Newnes.

Reference Books

1. MISRA. (2012). *MISRA C guidelines*. MISRA.
2. Yiu, J. (2019). *ARM Cortex M programming guide*. Newnes.
3. Buttazzo, G. (2011). *Hard real time computing systems*. Springer.
4. Tanenbaum, A. S., & Bos, H. (2015). *Modern operating systems*. Pearson.
5. ISO. (2018). *Functional safety standards overview*. ISO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

PROFESSIONAL ELECTIVE I (ADAS / RADAR SYSTEMS / POWER ELECTRONICS)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Gain specialized knowledge in chosen elective domain
2. Analyze advanced automotive or defence subsystems
3. Apply embedded technologies in specialization areas
4. Evaluate system level performance
5. Prepare for industry focused applications

Course Outcomes

CO1 Understand concepts of selected elective domain
CO2 Analyze system architectures and components
CO3 Apply embedded solutions to domain problems

CO4 Evaluate performance and safety constraints
CO5 Develop specialization oriented design capability

Detailed Syllabus

Unit I
Fundamental concepts of selected elective; system overview; application scope; functional blocks; performance requirements; regulatory and safety considerations.

Unit II
Core subsystems; sensors, actuators, power stages; signal processing chains; interface requirements; embedded processing constraints.

Unit III
Control strategies; algorithms; real time processing; data fusion concepts; reliability and fault tolerance considerations.

Unit IV
Implementation aspects; hardware platforms; software frameworks; testing methodologies; validation and verification practices.

Unit V
Case studies; industry applications; emerging trends; technology challenges; system integration perspectives.

Text Books

1. Rajamani, R. (2012). *Vehicle dynamics and control*. Springer.
2. Skolnik, M. I. (2008). *Radar handbook*. McGraw-Hill.
3. Erickson, R. W., & Maksimovic, D. (2001). *Fundamentals of power electronics*. Springer.
4. Bishop, R. (2005). *Mechatronic systems*. CRC Press.
5. Reif, K. (2015). *Automotive mechatronics*. Springer.

Reference Books

1. SAE. (2018). *ADAS standards and practices*. SAE.
2. Texas Instruments. (2020). *Power electronics application notes*. TI.
3. NATO. (2019). *Radar and surveillance systems*. NATO.
4. ISO. (2020). *Automotive safety standards*. ISO.
5. IEEE. (2021). *Embedded systems applications*. IEEE.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

EMBEDDED SYSTEMS LABORATORY

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop hands on skills in embedded system development
2. Apply processor and peripheral interfacing concepts
3. Implement embedded software and drivers
4. Use debugging and testing tools
5. Integrate hardware and software subsystems

Course Outcomes

CO1 Configure embedded hardware platforms
CO2 Develop and test embedded software programs
CO3 Interface peripherals and communication modules
CO4 Use debugging tools effectively
CO5 Validate embedded system functionality

List of Experiments / Exercises

1. Study of advanced microcontroller development boards, processor features, memory map analysis, clock configuration, power management setup.
2. Programming of GPIO, timers, and interrupts using embedded C, validation through debugging and timing measurements.
3. ADC and DAC interfacing, signal acquisition, data conversion accuracy analysis, calibration procedures.
4. Serial communication using UART, SPI, I2C, protocol configuration, data transfer verification.
5. CAN communication setup between nodes, frame transmission, error monitoring, bus arbitration observation.
6. Embedded driver development for peripherals, abstraction layers, modular code implementation.
7. RTOS based task creation, scheduling, inter task communication implementation and testing.
8. Low power mode configuration, power consumption measurement, optimization techniques.

9. Fault injection and debugging, exception handling, system recovery techniques.
10. Mini integrated embedded application combining peripherals, communication, and software modules.
11. Hardware software integration testing, performance evaluation, reliability checks.

Expected Outcomes

Practical competence in embedded hardware and software integration, protocol implementation, debugging proficiency, system level validation skills.

Evaluation Scheme

Continuous Assessment (100%)

INTERNSHIP / INDUSTRIAL TRAINING

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to industrial embedded systems environment
2. Apply theoretical knowledge to real applications
3. Understand professional practices and standards
4. Develop problem solving and teamwork skills
5. Prepare for advanced project work

Course Outcomes

CO1 Demonstrate understanding of industrial workflows
CO2 Apply embedded engineering skills in industry context
CO3 Follow professional and ethical practices
CO4 Document industrial training outcomes
CO5 Relate academic learning to industry applications

Guidelines

Industrial attachment in automotive, defence, or embedded systems organizations; supervised technical activities; periodic reporting; adherence to organizational rules; completion certificate mandatory.

Evaluation Scheme

Continuous Assessment (100%)

III SEMESTER – M.TECH. EMBEDDED SYSTEMS FOR AUTOMOTIVE & DEFENCE ELECTRONICS

FUNCTIONAL SAFETY & AUTOMOTIVE STANDARDS (ISO 26262)

Course Category
Automotive & Defence Specialization Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand functional safety concepts in automotive systems
2. Analyze hazards and risks in safety critical systems
3. Apply ISO 26262 lifecycle and compliance requirements
4. Design safety mechanisms for embedded systems
5. Prepare for safety oriented automotive engineering roles

Course Outcomes

CO1 Interpret functional safety principles and terminology
CO2 Perform hazard analysis and risk assessment
CO3 Apply ISO 26262 lifecycle processes
CO4 Design safety mechanisms in embedded systems
CO5 Evaluate compliance of automotive electronic systems

Detailed Syllabus

Unit I
Functional safety concepts; safety lifecycle overview; safety related systems; hazards, risks, severity; controllability, exposure; safety goals; automotive functional safety background, regulatory context, safety culture.

Unit II
Hazard analysis and risk assessment; HARA methodology; ASIL determination; safety requirements allocation; functional safety concept; item definition; risk classification, safety integrity levels, system decomposition.

Unit III
ISO 26262 system level processes; technical safety requirements; system architectural design; safety mechanisms; redundancy, monitoring; fault detection; diagnostic coverage, safe state concepts.

Unit IV
Hardware safety analysis; failure modes, effects analysis; fault tree analysis; probabilistic metrics; hardware architectural metrics; random hardware failures; reliability targets, quantitative safety evaluation.

Unit V
Software safety lifecycle; software safety requirements; verification and validation; tool qualification; safety case development; production, operation, decommissioning; compliance assessment, automotive case studies.

Text Books

1. ISO. (2018). *ISO 26262 road vehicles functional safety*. ISO.
2. Hobbs, C. (2015). *Automotive embedded systems handbook*. CRC Press.
3. Storey, N. (2017). *Safety critical computer systems*. Pearson.
4. Eriksson, L. (2016). *Functional safety for road vehicles*. Springer.
5. Bishop, R. (2005). *Mechatronic systems*. CRC Press.

Reference Books

1. IEC. (2010). *IEC 61508 functional safety*. IEC.
2. Blanchard, B. S., & Fabrycky, W. J. (2011). *Systems engineering*. Pearson.
3. Pecht, M. (2009). *Reliability engineering*. Wiley.
4. SAE. (2019). *Automotive safety practices*. SAE.
5. IEEE. (2021). *Safety critical systems guidelines*. IEEE.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

SECURE EMBEDDED SYSTEMS & CYBERSECURITY

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand security threats in embedded systems
2. Apply cryptographic techniques in embedded platforms
3. Design secure architectures and communication

4. Analyze vulnerabilities and countermeasures
5. Support secure automotive and defence systems

Course Outcomes

CO1 Identify embedded system security threats
CO2 Apply cryptographic primitives effectively
CO3 Design secure embedded architectures
CO4 Evaluate system vulnerabilities and risks
CO5 Implement security mechanisms in applications

Detailed Syllabus

Unit I
Embedded system security fundamentals; threat models; attack surfaces; hardware and software vulnerabilities; security requirements; automotive and defence security challenges, trust models, risk assessment basics.

Unit II
Cryptography fundamentals; symmetric, asymmetric algorithms; hashing; digital signatures; key management; hardware acceleration; performance constraints, embedded cryptographic implementations.

Unit III
Secure boot and firmware protection; root of trust; secure storage; trusted execution environments; authentication mechanisms; firmware update security, lifecycle protection strategies.

Unit IV
Communication security; secure protocols; encryption, authentication; intrusion detection; network security for automotive and defence systems; latency, reliability considerations.

Unit V
Security testing and validation; penetration testing; secure coding practices; standards overview; incident response; secure system case studies, compliance and certification perspectives.

Text Books

1. Wolf, M., Weimerskirch, A., & Paar, C. (2010). *Security in automotive bus systems*. Springer.
2. Anderson, R. (2020). *Security engineering*. Wiley.
3. Katz, J., & Lindell, Y. (2014). *Introduction to modern cryptography*. CRC Press.
4. Stallings, W. (2018). *Cryptography and network security*. Pearson.
5. Buchmann, J. (2013). *Introduction to cryptography*. Springer.

Reference Books

1. ISO. (2021). *Automotive cybersecurity standards*. ISO.
2. NIST. (2020). *Embedded system security guidelines*. NIST.
3. Ross Anderson. (2019). *Security engineering*. Wiley.
4. IEEE. (2022). *Cybersecurity for embedded systems*. IEEE.
5. SAE. (2020). *Automotive cybersecurity practices*. SAE.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

AVIONICS & DEFENCE EMBEDDED SYSTEMS

Course Category
Automotive & Defence Specialization Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand avionics and defence embedded architectures
2. Analyze airborne and mission critical systems
3. Study communication and navigation subsystems
4. Apply reliability and safety requirements
5. Prepare for defence embedded system development

Course Outcomes

CO1 Identify avionics and defence embedded architectures
CO2 Analyze airborne electronic subsystems
CO3 Apply mission critical design principles
CO4 Evaluate reliability and safety constraints
CO5 Design defence compliant embedded subsystems

Detailed Syllabus

Unit I
Avionics system overview; aircraft electronic architecture; integrated modular avionics; mission requirements; certification context; reliability and safety constraints, airborne system complexity.

Unit II

Flight control systems; sensors, actuators; control laws; redundancy; fault tolerance; real time constraints; embedded processing requirements for avionics applications.

Unit III

Navigation and communication systems; GPS, INS; data buses; ARINC standards; timing synchronization; secure communication considerations in defence avionics.

Unit IV

Mission computers; processing architectures; redundancy management; health monitoring; built in test equipment; fault management strategies, system availability requirements.

Unit V

Certification standards; DO 178, DO 254 overview; verification processes; documentation requirements; avionics case studies, defence embedded system integration challenges.

Text Books

1. Moir, I., & Seabridge, A. (2011). *Aircraft systems*. Wiley.
2. Spitzer, C. (2014). *Digital avionics handbook*. CRC Press.
3. Kordic, B. (2016). *Avionics systems*. Springer.
4. Pecht, M. (2009). *Reliability engineering*. Wiley.
5. Skolnik, M. I. (2008). *Radar handbook*. McGraw-Hill.

Reference Books

1. RTCA. (2011). *DO 178C software considerations*. RTCA.
2. RTCA. (2012). *DO 254 hardware considerations*. RTCA.
3. NATO. (2018). *Avionics and defence standards*. NATO.
4. Blanchard, B. S. (2011). *Systems engineering*. Pearson.
5. IEEE. (2020). *Avionics embedded systems*. IEEE.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

PROFESSIONAL ELECTIVE II (AUTONOMOUS VEHICLES / MISSILE GUIDANCE SYSTEMS)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop specialization in chosen advanced domain
2. Understand autonomous or guidance system principles
3. Apply embedded control and sensing techniques
4. Analyze performance and safety constraints
5. Enable advanced system level design skills

Course Outcomes

CO1 Explain principles of selected elective domain
CO2 Analyze system architectures and algorithms
CO3 Apply embedded technologies effectively
CO4 Evaluate performance and safety requirements
CO5 Design advanced application oriented solutions

Detailed Syllabus

Unit I
System overview of selected elective; application scope; functional architecture; sensing, computation, actuation blocks; performance and safety requirements.

Unit II
Sensors and perception systems; data acquisition; signal processing; sensor fusion concepts; accuracy, latency, robustness considerations.

Unit III
Control and guidance algorithms; path planning; estimation techniques; real time constraints; reliability and fault tolerance requirements.

Unit IV
Embedded implementation; hardware platforms; software frameworks; simulation and validation techniques; verification workflows.

Unit V
Case studies; operational scenarios; emerging technologies; challenges; future trends; system integration perspectives.

Text Books

1. Rajamani, R. (2012). *Vehicle dynamics and control*. Springer.
2. Beard, R. W., & McLain, T. (2012). *Small unmanned aircraft*. Princeton.
3. Zarchan, P. (2012). *Tactical and strategic missile guidance*. AIAA.
4. Bishop, R. (2005). *Mechatronic systems*. CRC Press.
5. Reif, K. (2015). *Automotive mechatronics*. Springer.

Reference Books

1. SAE. (2020). *Autonomous vehicle standards*. SAE.
2. NATO. (2019). *Guidance and navigation systems*. NATO.
3. IEEE. (2021). *Autonomous systems engineering*. IEEE.
4. ISO. (2021). *Automated driving standards*. ISO.
5. AIAA. (2018). *Missile and guidance technologies*. AIAA.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

OPEN ELECTIVE (AI FOR EMBEDDED SYSTEMS / IOT FOR DEFENCE)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce emerging technologies in embedded domains
2. Apply AI or IoT concepts to embedded systems
3. Analyze resource constrained intelligent systems
4. Evaluate application potential in defence systems
5. Support interdisciplinary system development

Course Outcomes

CO1 Understand AI or IoT fundamentals for embedded systems
CO2 Apply algorithms on embedded platforms
CO3 Analyze performance and resource constraints

CO4 Design application oriented solutions
CO5 Evaluate emerging technology trends

Detailed Syllabus

Unit I
Fundamentals of selected open elective; system architecture; application domains; computational requirements; embedded constraints; interdisciplinary perspectives.

Unit II
Data acquisition and preprocessing; feature extraction; model selection; training concepts; embedded implementation challenges.

Unit III
Edge intelligence; real time processing; optimization techniques; memory and power considerations; deployment strategies.

Unit IV
Communication and integration; networking aspects; security considerations; scalability; defence application requirements.

Unit V
Case studies; practical applications; limitations; future research directions; technology adoption challenges.

Text Books

1. Sze, V. (2020). *Efficient processing of deep neural networks*. Morgan Kaufmann.
2. Banerjee, A. (2019). *AI for embedded systems*. Elsevier.
3. Al Fuqaha, A. (2018). *IoT fundamentals*. Wiley.
4. Buyya, R. (2019). *Internet of Things*. Morgan Kaufmann.
5. Rajkumar, R. (2010). *Cyber physical systems*. CRC Press.

Reference Books

1. IEEE. (2022). *AI in embedded systems*. IEEE.
2. ISO. (2021). *IoT security standards*. ISO.
3. NIST. (2020). *Edge computing guidelines*. NIST.
4. SAE. (2021). *Defence IoT applications*. SAE.
5. Springer. (2022). *Embedded intelligence*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

MINOR PROJECT (INDUSTRY / DEFENCE APPLICATION)

Course Category
Project Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Apply embedded systems knowledge to real problems
2. Develop industry or defence oriented solutions
3. Practice project planning and execution
4. Enhance technical documentation skills
5. Prepare for major project work

Course Outcomes

CO1 Identify and define project objectives
CO2 Design and implement embedded solutions
CO3 Apply engineering tools and methodologies
CO4 Document and present project outcomes
CO5 Demonstrate professional project practices

Guidelines

Problem identification; literature survey; system design; implementation; testing and validation; periodic reviews; final report submission; project demonstration mandatory.

Evaluation Scheme

Continuous Assessment (100%)

Course 7: Internship

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Gain advanced industrial exposure
2. Apply specialization knowledge in practice
3. Understand organizational workflows

4. Develop professional competencies
5. Support transition to major project

Course Outcomes

CO1 Demonstrate industry level technical skills
CO2 Apply academic knowledge in real environments
CO3 Follow professional and ethical standards
CO4 Document internship activities
CO5 Relate internship learning to research projects

Guidelines

Internship in relevant automotive, avionics, or defence organizations; supervised technical work; progress reporting; completion certificate mandatory.

Evaluation Scheme

Continuous Assessment (100%)

IV SEMESTER – M.Tech. Embedded Systems for Automotive & Defence Electronics

INTELLECTUAL PROPERTY RIGHTS & TECHNOLOGY MANAGEMENT

Course Category
Humanities & Management Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Understand intellectual property systems and legal frameworks
2. Analyze patenting processes and technology protection
3. Apply IPR concepts in engineering innovation
4. Understand technology commercialization and management
5. Promote ethical and lawful use of intellectual assets

Course Outcomes

CO1 Identify different forms of intellectual property
CO2 Apply patent search and filing procedures
CO3 Analyze IPR issues in engineering domains
CO4 Understand technology transfer mechanisms
CO5 Apply ethical practices in intellectual property management

Detailed Syllabus

Unit I
Intellectual property overview; patents, copyrights, trademarks; industrial designs; geographical indications; international conventions; TRIPS agreement; role of IPR in innovation ecosystems, engineering relevance.

Unit II
Patent law fundamentals; patentability criteria; novelty, inventive step; industrial applicability; patent specification; claims drafting; patent search techniques; infringement, enforcement mechanisms.

Unit III
Copyright and related rights; software protection; licensing models; trademarks and branding; trade secrets; protection strategies; IPR management in technology driven organizations.

Unit IV
Technology management concepts; innovation lifecycle; technology forecasting; acquisition

and transfer; commercialization models; incubation, startups; government initiatives, industry academia collaboration.

Unit V
IPR valuation; licensing agreements; technology contracts; dispute resolution; ethics and compliance; case studies; Indian and global perspectives on technology management.

Text Books

1. Watal, J. (2016). *Intellectual property rights in the WTO and developing countries*. Oxford University Press.
2. Cornish, W., Llewelyn, D., & Aplin, T. (2019). *Intellectual property*. Sweet & Maxwell.
3. Ganguli, P. (2017). *Intellectual property rights*. Tata McGraw-Hill.
4. Trott, P. (2017). *Innovation management and new product development*. Pearson.
5. Tidd, J., & Bessant, J. (2018). *Managing innovation*. Wiley.

Reference Books

1. WIPO. (2020). *Intellectual property handbook*. WIPO.
2. Basheer, S. (2018). *Indian intellectual property law*. LexisNexis.
3. OECD. (2015). *Innovation and intellectual property*. OECD.
4. Rosenberg, N. (2004). *Innovation and economic growth*. Princeton University Press.
5. Drucker, P. F. (2007). *Innovation and entrepreneurship*. Harper.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

MAJOR PROJECT PHASE I

Course Category
Project Course

Credits / Contact Hours
6 Credits / 90 Contact Hours

Course Objectives

1. Identify research or industry relevant problem
2. Perform comprehensive literature review
3. Define project objectives and methodology

4. Develop preliminary system design
5. Prepare for full scale project execution

Course Outcomes

CO1 Identify and justify project problem statement
CO2 Conduct structured literature survey
CO3 Formulate methodology and design approach
CO4 Develop preliminary implementation plan
CO5 Present project proposal effectively

Guidelines

Topic finalization; literature review; requirement analysis; system architecture definition; methodology selection; project proposal preparation; periodic reviews; approval by departmental committee.

Evaluation Scheme

Continuous Assessment (100%)

MAJOR PROJECT PHASE II (INDUSTRY / RESEARCH BASED)

Course Category
Project Course

Credits / Contact Hours
8 Credits / 120 Contact Hours

Course Objectives

1. Implement approved project solution
2. Apply advanced embedded systems techniques
3. Perform testing, validation, and optimization
4. Document technical outcomes comprehensively
5. Demonstrate professional project execution

Course Outcomes

CO1 Implement embedded system solution
CO2 Apply tools and methodologies effectively
CO3 Validate system performance and reliability
CO4 Prepare detailed project report
CO5 Defend project work through presentation

Guidelines

System implementation; integration; testing and validation; performance analysis; result documentation; thesis preparation; project demonstration; evaluation by internal and external examiners.

Evaluation Scheme

Continuous Assessment (100%)

SEMINAR / VIVA-VOCE

Course Category
Project Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical presentation skills
2. Analyze recent research and technology trends
3. Enhance critical thinking and communication
4. Prepare for professional and academic interactions
5. Assess comprehensive program knowledge

Course Outcomes

CO1 Present technical topics effectively
CO2 Analyze and critique research literature
CO3 Communicate ideas with clarity
CO4 Respond to technical queries confidently
CO5 Demonstrate comprehensive subject understanding

Guidelines

Seminar topic selection; literature survey; structured presentation; use of technical references; viva voce examination; assessment by departmental panel.

Evaluation Scheme

Continuous Assessment (100%)

Integrated B.Tech. – M.Tech. in Robotics, Automation & Intelligent Manufacturing

Duration: 5 Years | 10 Semesters | Total Credits: 200

I SEMESTER

Mathematics I (Calculus & Linear Algebra)

Course Category: Basic Science Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Establish foundational understanding of differential and integral calculus for engineering applications
2. Develop competence in multivariable calculus and vector analysis
3. Introduce linear algebra concepts relevant to engineering systems
4. Enable mathematical modeling of physical and engineering problems
5. Strengthen analytical and problem-solving skills

Course Outcomes
CO1: Apply limits, continuity, and differentiation techniques to engineering problems
CO2: Solve integral calculus problems related to area, volume, and physical systems
CO3: Analyze functions of several variables using partial differentiation
CO4: Apply vector calculus concepts to physical and engineering fields
CO5: Use matrix algebra and linear systems in engineering applications

Detailed Syllabus

Unit I
Functions, limits, continuity; standard limits, algebra of limits; differentiability concepts, physical interpretation; differentiation rules, implicit differentiation, higher order derivatives; applications to engineering problems, optimization concepts, rate of change analysis, modeling of simple engineering systems.

Unit II
Applications of derivatives; mean value theorems, Taylor and Maclaurin series; maxima and minima of single variable functions; curvature, radius of curvature; error analysis, approximation techniques; engineering optimization problems, stability considerations, mathematical representation of system behavior.

Unit III
Integral calculus; definite and indefinite integrals, standard integrals; techniques of integration, substitution, integration by parts; applications of integrals to area, volume, surface area; engineering applications involving work, energy, center of mass, moment calculations.

Unit IV
Functions of several variables; partial derivatives, total derivatives; Jacobians, chain rule; extrema of functions of two variables; Lagrange multipliers; engineering applications involving constrained optimization, multivariable system modeling, sensitivity analysis, physical interpretation of partial derivatives.

Unit V
Linear algebra fundamentals; matrices, types of matrices, matrix operations; determinants, inverse of matrices; solution of linear systems, rank of matrices; eigenvalues and eigenvectors; engineering applications in systems analysis, vibrations, network analysis, and computational modeling.

Text Books

1. Kreyszig, E. (2019). *Advanced Engineering Mathematics* (10th ed.). Wiley.
2. Jain, R. K., & Iyengar, S. R. K. (2018). *Advanced Engineering Mathematics*. Narosa Publishing House.
3. Thomas, G. B., Weir, M. D., & Hass, J. (2021). *Thomas' Calculus* (14th ed.). Pearson.
4. Strang, G. (2019). *Linear Algebra and Its Applications* (5th ed.). Cengage Learning.
5. Erwin, K. (2017). *Applied Mathematics for Engineers*. McGraw-Hill Education.

Reference Books

1. Anton, H., Bivens, I., & Davis, S. (2018). *Calculus* (11th ed.). Wiley.
2. Zill, D. G., & Wright, W. S. (2019). *Advanced Engineering Mathematics*. Jones & Bartlett.
3. Lay, D. C., Lay, S. R., & McDonald, J. J. (2021). *Linear Algebra and Its Applications*. Pearson.
4. Boylestad, R. (2016). *Mathematics for Engineers*. Pearson Education.
5. Churchill, R. V., & Brown, J. W. (2018). *Complex Variables and Applications*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Physics (Mechanics, Sensors & Measurements)

Course Category: Basic Science Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Provide fundamental understanding of classical mechanics principles
2. Introduce sensor technologies and physical measurement systems
3. Develop knowledge of material properties and wave phenomena
4. Link physical concepts with engineering applications
5. Build experimental and analytical skills in physics-based systems

Course Outcomes
CO1: Apply mechanics principles to engineering problems
CO2: Analyze oscillatory and wave phenomena in physical systems
CO3: Understand sensor principles and measurement techniques
CO4: Relate material properties to engineering applications
CO5: Interpret experimental data and measurement results

Detailed Syllabus

Unit I
Newtonian mechanics; laws of motion, inertial and non-inertial frames; work, energy, power; conservation principles; center of mass, moment of inertia; rotational dynamics; engineering applications in machinery, robotics motion, and mechanical system analysis.

Unit II
Oscillations; simple harmonic motion, damped and forced oscillations; resonance phenomena; wave motion, transverse and longitudinal waves; acoustics basics; engineering relevance in vibration analysis, noise control, mechanical system stability, and dynamic response evaluation.

Unit III
Properties of matter; elasticity, stress–strain relations; bending of beams, torsion; fluid properties basics; surface tension and viscosity; engineering materials behavior, structural applications, micro-mechanical systems, and mechanical design considerations.

Unit IV
Sensors and transducers; classification, working principles; displacement, temperature, pressure, and optical sensors; signal characteristics; static and dynamic response; engineering measurement systems, data acquisition fundamentals, accuracy, precision, and error analysis.

Unit V
Measurement systems; units and standards; calibration methods; electrical measurement techniques; bridges, digital instruments; introduction to virtual instrumentation; engineering

applications in automation, robotics sensing, industrial monitoring, and quality assurance systems.

Text Books

1. Halliday, D., Resnick, R., & Walker, J. (2021). *Fundamentals of Physics* (11th ed.). Wiley.
2. Serway, R. A., & Jewett, J. W. (2019). *Physics for Scientists and Engineers*. Cengage Learning.
3. Sawhney, G. S. (2017). *Mechanical Measurements and Instrumentation*. McGraw-Hill.
4. Morris, A. S., & Langari, R. (2016). *Measurement and Instrumentation*. Academic Press.
5. Bansal, R. K. (2018). *A Textbook of Engineering Physics*. Laxmi Publications.

Reference Books

1. Tipler, P. A., & Mosca, G. (2018). *Physics for Scientists and Engineers*. Freeman.
2. Doebelin, E. O., & Manik, D. N. (2016). *Measurement Systems*. McGraw-Hill.
3. Goldstein, H. (2017). *Classical Mechanics*. Pearson.
4. Beckwith, T. G., Marangoni, R. D., & Lienhard, J. H. (2019). *Mechanical Measurements*. Pearson.
5. Fraden, J. (2016). *Handbook of Modern Sensors*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Chemistry / Environmental Science

Course Category: Basic Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide chemical principles relevant to engineering applications
2. Introduce material chemistry and corrosion concepts
3. Develop understanding of energy and electrochemical systems
4. Create awareness of environmental issues and sustainability
5. Promote responsible engineering practices

Course Outcomes
CO1: Apply chemical principles to engineering materials
CO2: Understand corrosion mechanisms and prevention methods
CO3: Analyze electrochemical and energy systems
CO4: Assess environmental challenges and sustainable solutions
CO5: Apply chemistry concepts in industrial contexts

Detailed Syllabus

Unit I
Atomic structure, periodic properties; chemical bonding, molecular structure; intermolecular forces; engineering relevance of bonding in materials; crystal structures, defects; influence of atomic arrangements on mechanical, electrical, and thermal properties of engineering materials.

Unit II
Water chemistry; hardness, alkalinity; water treatment methods; corrosion fundamentals, types of corrosion; corrosion prevention techniques; electrochemical basis; engineering materials degradation, protection strategies, industrial case studies, and material selection considerations.

Unit III
Electrochemistry; electrochemical cells, Nernst equation; batteries, fuel cells; energy storage systems; engineering applications in electric vehicles, renewable energy integration, and industrial power systems; material considerations and performance evaluation.

Unit IV
Fuels and combustion; calorific value; alternative fuels; polymers and composites; synthesis, properties; engineering applications of polymers; sustainability considerations, recycling methods, and impact on manufacturing and product lifecycle.

Unit V
Environmental science basics; ecosystems, biodiversity; air, water, soil pollution; waste management; environmental regulations; sustainable development goals; role of engineers in environmental protection, green technologies, and responsible industrial practices.

Text Books

1. Jain, P. C., & Jain, M. (2018). *Engineering Chemistry*. Dhanpat Rai Publishing.
2. Dara, S. S., & Umare, S. S. (2019). *A Textbook of Engineering Chemistry*. S. Chand.
3. Peavy, H. S., Row, D., & Tchobanoglous, G. (2017). *Environmental Engineering*. McGraw-Hill.
4. Moore, J. W., & Moore, E. A. (2016). *Environmental Chemistry*. Academic Press.
5. Bansal, R. K. (2017). *Engineering Chemistry*. Laxmi Publications.

Reference Books

1. Atkins, P., & Jones, L. (2018). *Chemical Principles*. Freeman.
2. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2017). *Chemistry for Environmental Engineering*. McGraw-Hill.
3. Fontana, M. G. (2016). *Corrosion Engineering*. McGraw-Hill.
4. Callister, W. D., & Rethwisch, D. G. (2020). *Materials Science and Engineering*. Wiley.
5. Masters, G. M., & Ela, W. P. (2019). *Introduction to Environmental Engineering and Science*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Introduction to Programming (C / Python)

Course Category: Engineering Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamental programming concepts
2. Develop problem-solving skills using algorithms
3. Familiarize students with C and Python syntax
4. Enable structured and modular program development
5. Prepare students for advanced computing courses

Course Outcomes
CO1: Write basic programs using C or Python
CO2: Apply control structures for problem solving
CO3: Use functions and data structures effectively
CO4: Debug and test programs systematically
CO5: Develop logical thinking for computational tasks

Detailed Syllabus

Unit I
Introduction to programming; problem solving steps; algorithms, flowcharts; programming paradigms; basics of C and Python; compilation, interpretation concepts; program structure; identifiers, variables, data types; input–output operations, simple programming exercises.

Unit II
Operators and expressions; arithmetic, relational, logical operators; control structures; conditional statements, looping constructs; program flow control; nested structures; application in engineering computations, decision-making problems, and iterative numerical solutions.

Unit III
Arrays and strings; one-dimensional and two-dimensional arrays; string handling functions; memory representation; basic pointer concepts; Python lists and strings; applications in data storage, numerical computations, and simple engineering data processing tasks.

Unit IV
Functions and modular programming; user-defined functions; parameter passing; recursion concepts; scope of variables; Python functions and modules; program organization; reusability, debugging strategies, and structured program development practices.

Unit V
File handling basics; reading and writing files; structured data storage; introduction to data structures; stacks, queues concepts; overview of Python libraries; applications in automation, data analysis, and engineering problem-solving environments.

Text Books

1. Kernighan, B. W., & Ritchie, D. M. (2017). *The C Programming Language*. Pearson.
2. Reema Thareja. (2019). *Programming in C*. Oxford University Press.
3. Downey, A. B. (2020). *Think Python*. O'Reilly Media.
4. Guttag, J. V. (2021). *Introduction to Computation and Programming Using Python*. MIT Press.
5. Kanetkar, Y. (2018). *Let Us C*. BPB Publications.

Reference Books

1. Horowitz, E., Sahni, S., & Anderson-Freed, S. (2017). *Fundamentals of Data Structures in C*. Universities Press.
2. Lutz, M. (2019). *Learning Python*. O'Reilly Media.
3. Balagurusamy, E. (2020). *Programming in ANSI C*. McGraw-Hill.
4. McGrath, M. (2018). *Python in Easy Steps*. In Easy Steps.
5. Sedgewick, R., & Wayne, K. (2016). *Introduction to Programming in C*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Basics of Electrical & Electronics Engineering

Course Category: Engineering Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce basic electrical engineering principles
2. Provide fundamentals of electronic components and circuits
3. Develop understanding of AC and DC systems
4. Link electrical concepts to automation applications
5. Build foundation for advanced electrical courses

Course Outcomes
CO1: Analyze basic electrical circuits
CO2: Understand AC and DC machine principles
CO3: Explain electronic components and devices
CO4: Apply electrical concepts in engineering systems
CO5: Interpret basic electrical measurements

Detailed Syllabus

Unit I
Electrical quantities; voltage, current, resistance; Ohm's law; Kirchhoff's laws; DC circuit analysis; series and parallel circuits; network reduction techniques; engineering applications in power distribution, automation systems, and basic electrical troubleshooting.

Unit II
AC fundamentals; sinusoidal waveforms; RMS, average values; phasor representation; impedance; single-phase AC circuits; power concepts; resonance; applications in electrical machines, power systems, and industrial electrical installations.

Unit III
Electrical machines overview; DC machines principles; transformers basics; working principles; characteristics; applications; energy conversion concepts; relevance in industrial automation, robotics actuation, and power management systems.

Unit IV
Semiconductor basics; diodes, transistors; rectifiers; amplifiers; operational amplifiers basics; electronic circuits fundamentals; signal conditioning; applications in control systems, sensors interfacing, and electronic control units.

Unit V
Electrical measurements; measuring instruments; voltmeters, ammeters; power measurement; safety practices; earthing; electrical standards; introduction to electrical drives; applications in industrial systems, automation panels, and maintenance engineering.

Text Books

1. Hughes, E. (2017). *Electrical and Electronic Technology*. Pearson.
2. Theraja, B. L., & Theraja, A. K. (2018). *A Textbook of Electrical Technology*. S. Chand.
3. Boylestad, R. L., & Nashelsky, L. (2019). *Electronic Devices and Circuit Theory*. Pearson.
4. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2017). *Electric Machinery*. McGraw-Hill.
5. Mehta, V. K., & Mehta, R. (2016). *Principles of Electronics*. S. Chand.

Reference Books

1. Alexander, C. K., & Sadiku, M. N. O. (2018). *Fundamentals of Electric Circuits*. McGraw-Hill.
2. Floyd, T. L. (2017). *Electronic Devices*. Pearson.
3. Sen, P. C. (2018). *Principles of Electric Machines and Power Electronics*. Wiley.
4. Del Toro, V. (2016). *Electrical Engineering Fundamentals*. Prentice Hall.
5. Wildi, T. (2017). *Electrical Machines, Drives, and Power Systems*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course

Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Improve technical communication skills
2. Develop professional writing competence
3. Enhance oral presentation abilities
4. Build interpersonal and teamwork skills
5. Prepare students for professional environments

Course Outcomes
CO1: Communicate effectively in professional contexts
CO2: Write technical and formal documents
CO3: Deliver structured oral presentations

CO4: Apply listening and interpersonal skills
CO5: Demonstrate workplace communication ethics

Detailed Syllabus

Unit I
Basics of communication; communication process; barriers; verbal and non-verbal communication; listening skills; professional etiquette; importance of communication in engineering, teamwork dynamics, and organizational effectiveness.

Unit II
Grammar essentials; sentence structure; vocabulary building; technical terminology; error correction; clarity and conciseness; written communication accuracy; application in reports, emails, and professional correspondence.

Unit III
Technical writing; reports, proposals; formatting standards; abstracts, summaries; documentation practices; professional emails; engineering documentation requirements; clarity, precision, and audience-oriented communication.

Unit IV
Oral communication; presentations skills; public speaking; group discussions; interviews; voice modulation; body language; professional interaction scenarios; engineering project presentations and technical meetings.

Unit V
Professional ethics in communication; cross-cultural communication; teamwork; leadership communication; workplace behavior; conflict management; corporate communication practices; career readiness and lifelong learning skills.

Text Books

1. Raman, M., & Sharma, S. (2017). *Technical Communication*. Oxford University Press.
2. Meenakshi Raman. (2019). *Professional Communication*. Oxford University Press.
3. Bovee, C. L., & Thill, J. V. (2018). *Business Communication Today*. Pearson.
4. Gerson, S. J., & Gerson, S. M. (2016). *Technical Communication*. Pearson.
5. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2019). *Business Communication*. McGraw-Hill.

Reference Books

1. Murphy, R. (2016). *English Grammar in Use*. Cambridge University Press.
2. Eastwood, J. (2018). *Oxford Practice Grammar*. Oxford University Press.

3. Adler, R. B., Rodman, G., & du Pré, A. (2017). *Interplay: The Process of Interpersonal Communication*. Oxford.
4. Chaney, L. H., & Martin, J. S. (2018). *Intercultural Business Communication*. Pearson.
5. Carnegie, D. (2017). *How to Win Friends and Influence People*. Simon & Schuster.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Graphics / Workshop Practice

Course Category: Engineering Science Course

Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Develop visualization and drafting skills
2. Understand engineering drawing standards
3. Introduce basic workshop practices
4. Build hands-on skills with tools and instruments
5. Enhance spatial understanding of components

Course Outcomes
CO1: Prepare basic engineering drawings
CO2: Interpret orthographic and isometric views
CO3: Apply drawing standards and conventions
CO4: Use basic workshop tools safely
CO5: Relate drawings to physical components

List of Experiments / Exercises

1. Practice of drawing instruments usage, line types, lettering, and dimensioning as per BIS standards, focusing on accuracy, neatness, and engineering drawing conventions.
2. Construction of orthographic projections of points and straight lines in different quadrants, using first-angle projection method and proper scaling techniques.
3. Projection of planes in various orientations, identification of true shapes, and interpretation of inclined surfaces relevant to engineering components.
4. Projection of simple solids such as prisms and cylinders, visualization of three-dimensional objects, and representation using standard projection methods.

5. Development of sectional views of solids, application of section planes, hatching techniques, and interpretation of internal features in mechanical components.
6. Preparation of isometric views from given orthographic drawings, proportion maintenance, spatial visualization, and conversion techniques.
7. Introduction to basic fitting tools, identification of hand tools, measurement instruments, and safe handling practices in workshop environments.
8. Simple fitting operations such as filing, marking, and drilling, focusing on dimensional accuracy, surface finish, and tool handling skills.
9. Demonstration of basic carpentry or sheet metal operations, understanding material behavior, cutting, joining, and forming processes.
10. Familiarization with workshop safety practices, machine tools overview, personal protective equipment usage, and basic maintenance awareness.

Expected Outcomes
Ability to visualize engineering components; proficiency in basic drawing techniques; understanding of workshop tools and safety; enhanced manual skills; linkage between drawings and physical components.

Evaluation Scheme
Continuous Assessment (100%)

II SEMESTER

Course 1: Mathematics II (Probability & Statistics)

Course Category: Basic Science Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Introduce probability theory fundamentals for engineering analysis
2. Develop statistical modeling skills for real-world data
3. Enable understanding of random variables and distributions
4. Apply statistical inference techniques in engineering contexts
5. Support data-driven decision making in engineering systems

Course Outcomes
CO1: Apply probability laws to engineering problems
CO2: Analyze discrete and continuous random variables
CO3: Use standard probability distributions for modeling
CO4: Perform statistical estimation and hypothesis testing
CO5: Interpret engineering data using statistical measures

Detailed Syllabus

Unit I
Probability fundamentals; sample space, events; axioms of probability; conditional probability; Bayes theorem; independent events; applications in engineering risk analysis, reliability estimation, uncertainty modeling, and decision making under probabilistic environments.

Unit II
Random variables; discrete and continuous random variables; probability mass and density functions; distribution functions; expectation, variance, moments; engineering interpretation of random phenomena, system variability, and stochastic modeling concepts.

Unit III
Standard distributions; binomial, Poisson, geometric distributions; normal, exponential distributions; properties, applications; central limit theorem; engineering applications in quality control, traffic flow, communication systems, and manufacturing process analysis.

Unit IV
Statistical data analysis; measures of central tendency, dispersion; correlation, regression analysis; curve fitting; least squares method; engineering applications in experimental data interpretation, modeling relationships, and performance prediction.

Unit V
Statistical inference; sampling methods; estimation theory; confidence intervals; hypothesis testing; chi-square, t-test, F-test; engineering applications in quality assurance, process validation, and data-based engineering decisions.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2018). *Probability and Statistics for Engineers and Scientists*. Pearson.
2. Jaynesh Jain, & Iyengar, S. R. K. (2019). *Probability and Statistics*. Narosa.
3. Devore, J. L. (2020). *Probability and Statistics for Engineering and the Sciences*. Cengage.
4. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.
5. Spiegel, M. R., Schiller, J. J., & Srinivasan, R. A. (2017). *Schaum's Outline of Probability and Statistics*. McGraw-Hill.

Reference Books

1. Ross, S. M. (2019). *Introduction to Probability Models*. Academic Press.
2. Papoulis, A., & Pillai, S. U. (2018). *Probability, Random Variables, and Stochastic Processes*. McGraw-Hill.
3. Hogg, R. V., McKean, J. W., & Craig, A. T. (2019). *Introduction to Mathematical Statistics*. Pearson.
4. Freund, J. E. (2016). *Mathematical Statistics*. Pearson.
5. Mood, A. M., Graybill, F. A., & Boes, D. C. (2018). *Introduction to the Theory of Statistics*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Materials Science & Manufacturing Processes

Course Category: Engineering Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce crystal structures and material properties
2. Explain mechanical behavior of engineering materials
3. Familiarize manufacturing processes and techniques

4. Relate material selection with manufacturing methods
5. Support design and production decision making

Course Outcomes
CO1: Understand structure–property relationships in materials
CO2: Analyze mechanical properties of engineering materials
CO3: Identify suitable manufacturing processes
CO4: Apply material selection principles
CO5: Relate manufacturing processes to product quality

Detailed Syllabus

Unit I
Atomic structure; crystal systems, unit cells; imperfections; diffusion mechanisms; bonding forces; structure–property relationships; relevance in metals, ceramics, polymers; engineering materials performance considerations.

Unit II
Mechanical properties; stress–strain behavior; elasticity, plasticity; hardness, toughness; creep, fatigue; testing methods; engineering significance in structural design, machine components, and material reliability assessment.

Unit III
Phase diagrams; equilibrium diagrams; lever rule; iron–carbon diagram; heat treatment processes; microstructure control; engineering applications in steels, alloys, and performance optimization through thermal processing.

Unit IV
Manufacturing processes; casting processes; molding materials; solidification principles; defects; machining processes; turning, milling, drilling; tool materials; surface finish; dimensional accuracy considerations.

Unit V
Forming and joining processes; forging, rolling, extrusion; welding, brazing, soldering; powder metallurgy; additive manufacturing overview; process selection criteria; sustainability and manufacturing efficiency considerations.

Text Books

1. Callister, W. D., & Rethwisch, D. G. (2020). *Materials Science and Engineering*. Wiley.
2. Groover, M. P. (2019). *Fundamentals of Modern Manufacturing*. Wiley.
3. Raghuwanshi, B. S. (2018). *Manufacturing Processes*. Laxmi Publications.
4. Avner, S. H. (2017). *Introduction to Physical Metallurgy*. McGraw-Hill.

5. Kalpakjian, S., & Schmid, S. (2018). *Manufacturing Engineering and Technology*. Pearson.

Reference Books

1. Dieter, G. E. (2017). *Mechanical Metallurgy*. McGraw-Hill.
2. ASM Handbook Committee. (2018). *ASM Handbook: Materials Selection*. ASM International.
3. Degarmo, E. P., Black, J. T., & Kohser, R. A. (2016). *Materials and Processes in Manufacturing*. Wiley.
4. Ashby, M. F. (2019). *Materials Selection in Mechanical Design*. Butterworth-Heinemann.
5. Schey, J. A. (2018). *Introduction to Manufacturing Processes*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Electronics & Logic Design

Course Category: Engineering Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce digital systems and number representation
2. Develop understanding of logic gates and circuits
3. Explain combinational and sequential logic design
4. Familiarize digital ICs and memory systems
5. Prepare foundation for embedded and control systems

Course Outcomes
CO1: Represent numbers and codes in digital systems
CO2: Analyze logic gates and Boolean expressions
CO3: Design combinational logic circuits
CO4: Understand sequential logic elements
CO5: Apply digital concepts in engineering systems

Detailed Syllabus

Unit I
Number systems; binary, octal, hexadecimal representations; conversions; binary arithmetic;

signed numbers; codes; BCD, ASCII; error detection codes; digital system fundamentals for engineering applications.

Unit II
Logic gates; Boolean algebra; De Morgan's theorems; logic simplification; Karnaugh maps; minimization techniques; implementation using logic gates; relevance in digital circuit efficiency and optimization.

Unit III
Combinational logic circuits; adders, subtractors; multiplexers, demultiplexers; encoders, decoders; comparators; design methodology; applications in arithmetic units, data routing, and digital processing systems.

Unit IV
Sequential logic circuits; latches, flip-flops; registers; counters; timing diagrams; state tables; state transition concepts; applications in control systems, automation logic, and digital controllers.

Unit V
Memory systems; ROM, RAM types; programmable logic devices; introduction to ADCs and DACs; digital IC families; characteristics; applications in embedded systems and automation hardware.

Text Books

1. Morris Mano, M., & Ciletti, M. (2017). *Digital Design*. Pearson.
2. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2018). *Digital Systems*. Pearson.
3. Floyd, T. L. (2017). *Digital Fundamentals*. Pearson.
4. Jain, R. P. (2019). *Modern Digital Electronics*. McGraw-Hill.
5. Gothmann, W. H. (2016). *Digital Electronics*. Prentice Hall.

Reference Books

1. Brown, S., & Vranesic, Z. (2019). *Fundamentals of Digital Logic with VHDL Design*. McGraw-Hill.
2. Katz, R. H., & Borriello, G. (2016). *Contemporary Logic Design*. Pearson.
3. Salivahanan, S., Shanmugam, A., & Kumar, A. V. (2018). *Digital Circuits and Design*. Oxford.
4. Roth, C. H., & Kinney, L. L. (2017). *Fundamentals of Logic Design*. Cengage.
5. Wakerly, J. F. (2018). *Digital Design: Principles and Practices*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Object-Oriented Programming

Course Category: Engineering Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce object-oriented programming principles
2. Develop programming skills using classes and objects
3. Explain inheritance and polymorphism concepts
4. Promote modular and reusable software design
5. Prepare foundation for advanced software systems

Course Outcomes
CO1: Apply object-oriented concepts in program design
CO2: Implement classes and objects
CO3: Use inheritance and polymorphism effectively
CO4: Apply exception handling and file operations
CO5: Develop structured, maintainable programs

Detailed Syllabus

Unit I
Object-oriented programming concepts; procedural versus object-oriented approach; classes, objects; data abstraction, encapsulation; program structure; relevance in software engineering and system modeling.

Unit II
Constructors and destructors; access specifiers; member functions; inline functions; static members; object initialization; engineering software development practices and modular program organization.

Unit III
Inheritance concepts; single, multilevel inheritance; method overriding; polymorphism; virtual functions; dynamic binding; applications in reusable software components and scalable system design.

Unit IV
Operator overloading; templates; exception handling; error management; program robustness; debugging strategies; applications in complex engineering software systems.

Unit V
File handling; input–output streams; persistent data storage; introduction to standard libraries;

overview of object-oriented design principles; applications in automation software and engineering applications.

Text Books

1. Stroustrup, B. (2018). *The C++ Programming Language*. Pearson.
2. Balagurusamy, E. (2020). *Object-Oriented Programming with C++*. McGraw-Hill.
3. Deitel, P. J., & Deitel, H. M. (2019). *C++ How to Program*. Pearson.
4. Lafore, R. (2017). *Object-Oriented Programming in C++*. SAMS.
5. Savitch, W. (2018). *Problem Solving with C++*. Pearson.

Reference Books

1. Schildt, H. (2017). *C++: The Complete Reference*. McGraw-Hill.
2. Horstmann, C. S. (2019). *C++ for Everyone*. Wiley.
3. Booch, G. (2017). *Object-Oriented Analysis and Design*. Pearson.
4. Lippman, S. B., Lajoie, J., & Moo, B. E. (2016). *C++ Primer*. Addison-Wesley.
5. Meyer, B. (2018). *Object-Oriented Software Construction*. Prentice Hall.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Mechanics

Course Category: Engineering Science Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamentals of statics and dynamics
2. Develop problem-solving skills in mechanics
3. Explain force systems and equilibrium conditions
4. Analyze motion of particles and rigid bodies
5. Support mechanical and automation applications

Course Outcomes
CO1: Apply force systems and equilibrium principles
CO2: Analyze trusses and structural components
CO3: Solve kinematics problems of particles

CO4: Apply laws of motion to engineering systems
CO5: Understand dynamics of rigid bodies

Detailed Syllabus

Unit I
Statics fundamentals; force systems; resultants; equilibrium of particles; free body diagrams; friction laws; applications in engineering structures, machinery, and mechanical component analysis.

Unit II
Equilibrium of rigid bodies; moments, couples; support reactions; trusses; method of joints, sections; applications in frames, structures, and load analysis.

Unit III
Kinematics of particles; rectilinear and curvilinear motion; displacement, velocity, acceleration; relative motion; applications in mechanical systems and robotic motion analysis.

Unit IV
Dynamics of particles; Newton's laws; work–energy principle; impulse and momentum; engineering applications in impact analysis, machinery dynamics, and motion control.

Unit V
Dynamics of rigid bodies; plane motion; rotation about fixed axis; energy methods; applications in mechanical systems, automation equipment, and dynamic stability considerations.

Text Books

1. Hibbeler, R. C. (2017). *Engineering Mechanics*. Pearson.
2. Beer, F. P., Johnston, E. R., Mazurek, D. F., Cornwell, P. J., & Self, B. P. (2018). *Vector Mechanics for Engineers*. McGraw-Hill.
3. Bansal, R. K. (2019). *Engineering Mechanics*. Laxmi Publications.
4. Meriam, J. L., & Kraige, L. G. (2018). *Engineering Mechanics*. Wiley.
5. Timoshenko, S. P., & Young, D. H. (2017). *Engineering Mechanics*. McGraw-Hill.

Reference Books

1. Popov, E. P. (2016). *Engineering Mechanics of Solids*. Pearson.
2. Shames, I. H. (2017). *Engineering Mechanics*. Prentice Hall.
3. Boresi, A. P., Schmidt, R. J., & Sidebottom, O. M. (2018). *Advanced Mechanics of Materials*. Wiley.
4. Tongue, B. H., & Sheppard, S. D. (2019). *Statics and Dynamics*. Wiley.

5. Bedford, A., & Fowler, W. (2017). *Engineering Mechanics*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation

Course Category: Humanities & Management Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce design thinking methodology
2. Develop creative problem-solving skills
3. Encourage user-centered design approach
4. Promote innovation and entrepreneurship mindset
5. Apply design tools in engineering contexts

Course Outcomes
CO1: Apply design thinking principles
CO2: Identify user needs and constraints
CO3: Generate creative design solutions
CO4: Develop prototypes and concepts
CO5: Demonstrate innovation-oriented thinking

Detailed Syllabus

Unit I
Design thinking fundamentals; human-centered design; problem identification; empathy mapping; user needs analysis; relevance to engineering innovation and product development.

Unit II
Creativity tools; brainstorming techniques; ideation methods; lateral thinking; design constraints; applications in engineering problem solving and concept generation.

Unit III
Concept development; feasibility analysis; design specifications; value proposition; engineering constraints; sustainability considerations in innovative design solutions.

Unit IV
Prototyping methods; low-fidelity, high-fidelity prototypes; testing and validation; iteration cycles; engineering applications in product and system development.

Unit V
Innovation management; entrepreneurship basics; intellectual property awareness; commercialization strategies; case studies; role of engineers in innovation ecosystems.

Text Books

1. Brown, T. (2019). *Change by Design*. Harper Business.
2. Liedtka, J., King, A., & Bennett, K. (2017). *Solving Problems with Design Thinking*. Columbia University Press.
3. Kumar, V. (2016). *101 Design Methods*. Wiley.
4. Ulrich, K. T., & Eppinger, S. D. (2019). *Product Design and Development*. McGraw-Hill.
5. Kelley, T., & Kelley, D. (2018). *Creative Confidence*. Crown Business.

Reference Books

1. Osterwalder, A., & Pigneur, Y. (2017). *Business Model Generation*. Wiley.
2. Ries, E. (2018). *The Lean Startup*. Crown Business.
3. Tidd, J., & Bessant, J. (2018). *Managing Innovation*. Wiley.
4. Drucker, P. F. (2017). *Innovation and Entrepreneurship*. Harper.
5. IDEO. (2016). *The Field Guide to Human-Centered Design*. IDEO.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship / Industrial Orientation

Course Category: Internship / Industrial Training Course

Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industrial environment
2. Understand organizational structure and processes
3. Relate theory with industrial practices
4. Develop professional ethics and discipline
5. Build awareness of engineering roles

Course Outcomes
CO1: Understand industrial operations

CO2: Observe engineering practices
CO3: Follow workplace safety norms
CO4: Demonstrate professional conduct
CO5: Prepare basic industrial reports

Guidelines
• Orientation visits to industries or research centers
• Interaction with industry professionals
• Observation of manufacturing, automation, or service processes
• Maintenance of internship diary and attendance

Evaluation Scheme
Continuous Assessment (100%)

III SEMESTER SYLLABUS

Course 1: Signals & Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Establish mathematical representation of signals and systems
2. Develop analytical skills for continuous and discrete systems
3. Introduce transform techniques for system analysis
4. Relate system properties to engineering applications
5. Build foundation for control, communication, and automation courses

Course Outcomes
CO1: Classify and represent continuous and discrete signals
CO2: Analyze system properties and responses
CO3: Apply convolution techniques for system output evaluation
CO4: Use Laplace and Z-transform methods
CO5: Interpret frequency domain characteristics of systems

Detailed Syllabus

Unit I
Signals classification, continuous time, discrete time, deterministic, random, periodic, aperiodic signals; mathematical representation, basic operations, time shifting, scaling; unit step, impulse functions; engineering relevance in physical and automation systems.

Unit II
System classification; linear, nonlinear, time invariant, time variant, causal, noncausal systems; system properties; block diagram representation; interconnections; engineering interpretation of system behavior in electrical, mechanical, and automation domains.

Unit III
Linear time invariant systems; impulse response; convolution integral and summation; graphical and analytical convolution; properties of convolution; applications in signal processing, control systems, and response analysis of engineering systems.

Unit IV
Continuous time Fourier series and Fourier transform; frequency spectrum; properties; energy and power signals; bandwidth concepts; engineering applications in communication systems, vibration analysis, and signal characterization.

Unit V
Laplace transform; properties; inverse Laplace; system transfer functions; poles and zeros; stability concepts; Z-transform basics; discrete system analysis; applications in control systems and digital signal processing.

Text Books

1. Oppenheim, A. V., Willsky, A. S., & Nawab, S. H. (2019). *Signals and Systems*. Pearson.
2. Lathi, B. P. (2018). *Linear Systems and Signals*. Oxford University Press.
3. Haykin, S., & Van Veen, B. (2017). *Signals and Systems*. Wiley.
4. Roberts, M. J. (2016). *Signals and Systems*. McGraw-Hill.
5. Simon Haykin. (2019). *Communication Systems*. Wiley.

Reference Books

1. Proakis, J. G., & Manolakis, D. G. (2018). *Digital Signal Processing*. Pearson.
2. Carlson, A. B. (2017). *Communication Systems*. McGraw-Hill.
3. Hsu, H. P. (2016). *Signals and Systems*. McGraw-Hill.
4. Papoulis, A. (2018). *Signal Analysis*. McGraw-Hill.
5. Sklar, B. (2019). *Digital Communications*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Sensors, Transducers & Instrumentation

Course Category: Core Engineering Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Introduce principles of sensors and transducers
2. Explain measurement systems and instrumentation blocks
3. Develop understanding of sensor characteristics
4. Relate instrumentation to automation applications
5. Build foundation for industrial measurement systems

Course Outcomes
CO1: Identify sensor types and operating principles

CO2: Analyze static and dynamic sensor characteristics
CO3: Apply instrumentation techniques for measurements
CO4: Select suitable sensors for applications
CO5: Interpret measurement data accurately

Detailed Syllabus

Unit I
Measurement fundamentals; units, standards; accuracy, precision; errors; calibration techniques; instrumentation block diagram; signal conditioning basics; relevance in industrial measurement, automation, and quality control systems.

Unit II
Transducers classification; resistive, inductive, capacitive transducers; displacement, force, pressure measurement; characteristics and applications; engineering relevance in robotics, automation, and mechanical systems.

Unit III
Temperature measurement; thermocouples, RTDs, thermistors; flow measurement techniques; electromagnetic, ultrasonic methods; level measurement; applications in process industries and automated manufacturing systems.

Unit IV
Optical, magnetic, and smart sensors; proximity sensors; encoders; piezoelectric sensors; MEMS sensors overview; sensor interfacing concepts; applications in robotics, motion control, and intelligent systems.

Unit V
Instrumentation systems; data acquisition systems; analog and digital signal processing basics; industrial instrumentation standards; applications in automation, monitoring, and control of engineering processes.

Text Books

1. Doebelin, E. O., & Manik, D. N. (2016). *Measurement Systems*. McGraw-Hill.
2. Morris, A. S., & Langari, R. (2016). *Measurement and Instrumentation*. Academic Press.
3. Patranabis, D. (2018). *Sensors and Transducers*. PHI Learning.
4. Bentley, J. P. (2019). *Principles of Measurement Systems*. Pearson.
5. Webster, J. G. (2017). *Measurement, Instrumentation, and Sensors Handbook*. CRC Press.

Reference Books

1. Fraden, J. (2016). *Handbook of Modern Sensors*. Springer.

2. Figliola, R. S., & Beasley, D. E. (2018). *Theory and Design for Mechanical Measurements*. Wiley.
3. Turner, J. D. (2017). *Instrumentation Sensors and Transducers*. Elsevier.
4. Ramanathan, K. (2019). *Industrial Instrumentation*. Tata McGraw-Hill.
5. Nakra, B. C., & Chaudhry, K. K. (2018). *Instrumentation, Measurement and Analysis*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Analog Electronics & Linear Circuits

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce analog electronic components and circuits
2. Develop analysis skills for amplifiers
3. Explain frequency response of circuits
4. Familiarize operational amplifier applications
5. Support electronics foundation for automation systems

Course Outcomes
CO1: Analyze diode and transistor circuits
CO2: Design basic amplifier circuits
CO3: Interpret frequency response characteristics
CO4: Apply operational amplifiers in circuits
CO5: Relate analog electronics to control systems

Detailed Syllabus

Unit I
Semiconductor fundamentals; PN junction diode characteristics; rectifiers; filters; voltage regulators; applications in power supplies and electronic systems used in automation and control environments.

Unit II
BJT operation; configurations; biasing techniques; small signal models; amplifier analysis; performance parameters; applications in signal amplification and electronic control circuits.

Unit III
FETs; JFET, MOSFET characteristics; biasing; amplifiers; comparison with BJTs; applications in low-noise amplifiers and switching circuits in automation systems.

Unit IV
Operational amplifiers; ideal and practical characteristics; inverting, non-inverting amplifiers; summing, integrator, differentiator circuits; applications in signal conditioning and control systems.

Unit V
Frequency response of amplifiers; gain bandwidth product; feedback amplifiers; oscillators basics; applications in communication, control, and automation electronics.

Text Books

1. Boylestad, R. L., & Nashelsky, L. (2019). *Electronic Devices and Circuit Theory*. Pearson.
2. Sedra, A. S., & Smith, K. C. (2017). *Microelectronic Circuits*. Oxford University Press.
3. Millman, J., & Halkias, C. (2016). *Integrated Electronics*. McGraw-Hill.
4. Floyd, T. L. (2017). *Electronic Devices*. Pearson.
5. Razavi, B. (2018). *Fundamentals of Microelectronics*. Wiley.

Reference Books

1. Malvino, A. (2017). *Electronic Principles*. McGraw-Hill.
2. Streetman, B. G., & Banerjee, S. (2016). *Solid State Electronic Devices*. Pearson.
3. Gray, P. R., & Meyer, R. G. (2018). *Analysis and Design of Analog Integrated Circuits*. Wiley.
4. Franco, S. (2019). *Design with Operational Amplifiers*. McGraw-Hill.
5. Horowitz, P., & Hill, W. (2017). *The Art of Electronics*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Microprocessors & Microcontrollers

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce architecture of microprocessors and microcontrollers
2. Develop assembly level programming skills
3. Explain interfacing techniques
4. Familiarize embedded system concepts
5. Prepare foundation for automation controllers

Course Outcomes
CO1: Understand microprocessor architecture
CO2: Write basic assembly programs
CO3: Interface memory and peripherals
CO4: Explain microcontroller features
CO5: Apply embedded concepts in automation

Detailed Syllabus

Unit I
Microprocessor overview; architecture; instruction set; addressing modes; timing diagrams; applications in control and automation systems.

Unit II
Assembly language programming; data transfer, arithmetic, logical instructions; program control; delay routines; applications in system control.

Unit III
Interfacing concepts; memory interfacing; I/O interfacing; programmable peripheral devices; applications in automation hardware.

Unit IV
Microcontroller architecture; internal organization; timers, interrupts; serial communication; applications in embedded control systems.

Unit V
Embedded system basics; development tools; interfacing sensors and actuators; applications in robotics and intelligent manufacturing.

Text Books

1. Ramesh S. Gaonkar. (2018). *Microprocessor Architecture, Programming, and Applications*. Wiley.

2. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. (2016). *The 8051 Microcontroller*. Pearson.
3. Ray, A. K., & Bhurchandi, K. M. (2017). *Advanced Microprocessors and Peripherals*. McGraw-Hill.
4. Krishna Kant. (2019). *Microprocessors and Microcontrollers*. PHI.
5. Ayala, K. J. (2018). *The 8051 Microcontroller Architecture*. Cengage.

Reference Books

1. Brey, B. B. (2017). *The Intel Microprocessors*. Pearson.
2. Barret, S., & Pack, D. (2016). *Microcontrollers Fundamentals for Engineers*. Morgan & Claypool.
3. Valvano, J. (2019). *Embedded Systems*. Cengage.
4. Peatman, J. B. (2017). *Design with Microcontrollers*. McGraw-Hill.
5. Simon, D. (2018). *Embedded Systems Software Primer*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Fluid Power Systems (Hydraulics & Pneumatics)

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fluid power principles
2. Explain hydraulic and pneumatic components
3. Develop system design understanding
4. Relate fluid power to automation
5. Build foundation for industrial applications

Course Outcomes
CO1: Understand fluid properties and laws
CO2: Identify hydraulic components
CO3: Analyze pneumatic systems
CO4: Design basic fluid power circuits
CO5: Apply fluid power in automation

Detailed Syllabus

Unit I
Fluid properties; pressure, flow; Pascal's law; continuity equation; energy equation; applications in hydraulic systems.

Unit II
Hydraulic pumps; actuators; valves; symbols; circuits; performance analysis; industrial applications.

Unit III
Hydraulic control circuits; speed control; sequencing; safety considerations; applications in automation machinery.

Unit IV
Pneumatic systems; compressors; air treatment; valves; actuators; circuit design; applications in industrial automation.

Unit V
Fluid power system design; maintenance; troubleshooting; energy efficiency; industrial safety standards.

Text Books

1. Esposito, A. (2017). *Fluid Power with Applications*. Pearson.
2. Majumdar, S. R. (2018). *Oil Hydraulic Systems*. Tata McGraw-Hill.
3. Parr, A. (2016). *Hydraulics and Pneumatics*. Butterworth-Heinemann.
4. Bennett, S. (2019). *Hydraulic Control Systems*. Wiley.
5. Bolton, W. (2018). *Pneumatic and Hydraulic Systems*. Elsevier.

Reference Books

1. Cundiff, J. S. (2017). *Fluid Power Circuits and Controls*. CRC Press.
2. Viersma, T. J. (2018). *Analysis, Synthesis, and Design of Hydraulic Servo Systems*. Elsevier.
3. Helduser, S. (2016). *Hydraulic Drives and Controls*. Springer.
4. Watton, J. (2019). *Fundamentals of Fluid Power Control*. Cambridge.
5. Dransfield, P. (2018). *Hydraulic Control Systems*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Ethics / Industrial Psychology)

Course Category: Humanities & Management Course

Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop ethical awareness in engineering practice
2. Understand human behavior in industrial environments
3. Promote professional responsibility
4. Enhance teamwork and leadership skills
5. Support holistic engineer development

Course Outcomes
CO1: Apply ethical principles in engineering decisions
CO2: Understand industrial psychology concepts
CO3: Demonstrate professional responsibility
CO4: Improve interpersonal skills
CO5: Analyze workplace behavior

Detailed Syllabus

Unit I
Engineering ethics; professional responsibilities; codes of conduct; ethical dilemmas; relevance to engineering practice.

Unit II
Human behavior; motivation theories; perception; learning; applications in industrial settings.

Unit III
Group dynamics; teamwork; leadership styles; communication; conflict management in organizations.

Unit IV
Workplace psychology; stress management; job satisfaction; ergonomics; productivity improvement.

Unit V
Social responsibility; sustainability ethics; corporate governance; role of engineers in society.

Text Books

1. Harris, C. E., Pritchard, M. S., & Rabins, M. J. (2019). *Engineering Ethics*. Cengage.
2. Robbins, S. P. (2018). *Organizational Behavior*. Pearson.
3. Velasquez, M. G. (2017). *Business Ethics*. Pearson.

4. Moorhead, G., & Griffin, R. W. (2019). *Organizational Behavior*. Cengage.
5. Martin, M. W., & Schinzinger, R. (2017). *Ethics in Engineering*. McGraw-Hill.

Reference Books

1. Northouse, P. G. (2018). *Leadership*. Sage.
2. Griffin, R. W. (2017). *Management*. Cengage.
3. Raju, M. S. V. (2016). *Ethics and Values in Engineering*. Pearson.
4. Baron, R. A. (2019). *Behavior in Organizations*. Pearson.
5. Drucker, P. F. (2017). *Management Challenges*. Harper.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course

Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide hands-on industrial exposure
2. Relate theory with practice
3. Develop professional discipline
4. Understand industrial workflows
5. Build reporting and observation skills

Course Outcomes
CO1: Observe industrial systems and processes
CO2: Follow safety and professional norms
CO3: Relate academic knowledge to practice
CO4: Prepare structured internship reports
CO5: Demonstrate professional conduct

Guidelines
• Industry attachment or field-based training
• Observation of automation, manufacturing, or robotics systems
• Maintenance of logbook and attendance

Evaluation Scheme
Continuous Assessment (100%)

IV SEMESTER

Course 1: Control Systems Engineering

Course Category: Core Engineering Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical modeling skills for dynamic systems
2. Introduce feedback control concepts and architectures
3. Analyze time-domain system performance
4. Apply frequency-domain techniques for stability analysis
5. Build foundation for automation and robotics control

Course Outcomes
CO1: Model physical systems using differential equations
CO2: Analyze control system responses in time domain
CO3: Apply stability criteria for control systems
CO4: Use frequency response methods for analysis
CO5: Interpret control performance specifications

Detailed Syllabus

Unit I
Control system concepts; open loop, closed loop systems; feedback principles; control system components; mathematical modeling of electrical, mechanical systems; transfer function representation; block diagram algebra; signal flow graphs, Mason's gain formula.

Unit II
Time domain analysis; standard test signals; first order and second order systems; transient response specifications; steady state error; static error constants; engineering interpretation of system performance and accuracy.

Unit III
Stability analysis; concept of stability; characteristic equation; Routh–Hurwitz criterion; relative stability; root locus technique; construction rules; effect of pole, zero locations on system response.

Unit IV
Frequency domain analysis; sinusoidal steady state response; Bode plots; gain margin, phase margin; Nyquist stability criterion; engineering significance in robustness and performance evaluation of control systems.

Unit V
Compensation techniques; lead, lag, lead–lag compensators; design using root locus and frequency response methods; introduction to state space concepts; relevance to modern control and automation systems.

Text Books

1. Ogata, K. (2018). *Modern Control Engineering*. Pearson.
2. Nise, N. S. (2019). *Control Systems Engineering*. Wiley.
3. Dorf, R. C., & Bishop, R. H. (2017). *Modern Control Systems*. Pearson.
4. Gopal, M. (2018). *Control Systems: Principles and Design*. Tata McGraw-Hill.
5. Kuo, B. C. (2017). *Automatic Control Systems*. Wiley.

Reference Books

1. Franklin, G. F., Powell, J. D., & Emami-Naeini, A. (2019). *Feedback Control of Dynamic Systems*. Pearson.
2. D'Azzo, J. J., & Houpis, C. H. (2017). *Linear Control System Analysis*. McGraw-Hill.
3. Phillips, C. L., & Harbor, R. D. (2018). *Feedback Control Systems*. Pearson.
4. Kailath, T. (2017). *Linear Systems*. Prentice Hall.
5. Chen, C. T. (2016). *Linear System Theory and Design*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Industrial Automation & PLC Programming

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce industrial automation architectures
2. Explain PLC hardware and software concepts
3. Develop PLC programming skills
4. Integrate sensors and actuators using PLCs
5. Apply automation concepts in industrial systems

Course Outcomes
CO1: Understand industrial automation systems

CO2: Explain PLC architecture and components
CO3: Develop ladder logic programs
CO4: Interface field devices with PLCs
CO5: Analyze automated industrial processes

Detailed Syllabus

Unit I
Industrial automation overview; automation levels; manufacturing automation systems; components; sensors, actuators; control architectures; relevance in modern manufacturing and intelligent production systems.

Unit II
PLC fundamentals; architecture; CPU, memory, I/O modules; PLC hardware; power supply; communication interfaces; advantages over conventional control systems.

Unit III
PLC programming concepts; ladder logic elements; timers, counters; program scan cycle; interlocking; sequencing; applications in industrial process control.

Unit IV
PLC interfacing; digital and analog I/O; signal conditioning; interfacing sensors, actuators; communication protocols basics; industrial networking concepts.

Unit V
Industrial automation applications; conveyor control; batch processing; safety considerations; introduction to SCADA concepts; automation case studies in manufacturing environments.

Text Books

1. Bolton, W. (2019). *Programmable Logic Controllers*. Elsevier.
2. Petruzella, F. D. (2017). *Programmable Logic Controllers*. McGraw-Hill.
3. Frank D. Petruzella. (2018). *Industrial Electronics*. McGraw-Hill.
4. Majumdar, S. R. (2017). *Industrial Automation*. Tata McGraw-Hill.
5. Parr, E. A. (2016). *Industrial Control Handbook*. Butterworth-Heinemann.

Reference Books

1. Hackworth, J. R., & Hackworth, F. D. (2018). *Programmable Logic Controllers*. Pearson.
2. Webb, J. W., & Reis, R. A. (2017). *Programmable Logic Controllers: Principles and Applications*. Pearson.
3. Hugh Jack. (2019). *Automating Manufacturing Systems with PLCs*. Lulu Press.
4. Boyer, S. A. (2018). *SCADA: Supervisory Control and Data Acquisition*. ISA.

5. Bramble, M. W., & King, J. C. (2016). *Industrial Automation*. Elsevier.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Electrical Machines & Drives

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Explain operating principles of electrical machines
2. Analyze performance characteristics of machines
3. Introduce electric drives and control methods
4. Relate machines to industrial applications
5. Build foundation for automation drives

Course Outcomes
CO1: Understand DC and AC machine principles
CO2: Analyze characteristics of electrical machines
CO3: Explain transformers and induction motors
CO4: Understand electric drive concepts
CO5: Apply machines in industrial automation

Detailed Syllabus

Unit I
Magnetic circuits; EMF generation principles; DC machines construction; operating characteristics; losses; efficiency; applications in industrial drives and automation systems.

Unit II
Transformers; construction; principle of operation; equivalent circuit; performance characteristics; losses; applications in power distribution and industrial systems.

Unit III
Induction motors; construction; principle; torque–speed characteristics; starting methods; speed control; applications in industrial automation.

Unit IV
Synchronous machines; alternators and motors; operating principles; characteristics; power factor control; applications in industrial power systems.

Unit V
Electric drives; classification; load characteristics; speed control methods; introduction to power electronic drives; industrial drive applications.

Text Books

1. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2017). *Electric Machinery*. McGraw-Hill.
2. P. S. Bimbhra. (2018). *Electrical Machinery*. Khanna Publishers.
3. Wildi, T. (2017). *Electrical Machines, Drives, and Power Systems*. Pearson.
4. Nagrath, I. J., & Kothari, D. P. (2016). *Electric Machines*. McGraw-Hill.
5. Sen, P. C. (2018). *Principles of Electric Machines and Power Electronics*. Wiley.

Reference Books

1. Chapman, S. J. (2016). *Electric Machinery Fundamentals*. McGraw-Hill.
2. Dubey, G. K. (2017). *Fundamentals of Electrical Drives*. Narosa.
3. Bose, B. K. (2018). *Modern Power Electronics and AC Drives*. Prentice Hall.
4. Krause, P. C. (2017). *Analysis of Electric Machinery*. Wiley.
5. Leonhard, W. (2016). *Control of Electrical Drives*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Robotics Engineering Fundamentals

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce basic concepts of robotics
2. Explain robot configurations and components
3. Develop understanding of robot kinematics
4. Familiarize industrial robot applications
5. Build foundation for advanced robotics courses

Course Outcomes
CO1: Understand robot structures and classifications
CO2: Analyze robot kinematics basics

CO3: Explain robot actuation and sensing
CO4: Identify industrial robot applications
CO5: Interpret basic robot control concepts

Detailed Syllabus

Unit I
Robotics overview; history; robot classification; industrial robots; robot anatomy; degrees of freedom; coordinate frames; relevance in manufacturing and automation.

Unit II
Robot kinematics; forward kinematics; position and orientation representation; homogeneous transformation matrices; engineering interpretation of robot motion.

Unit III
Robot actuators; electric, hydraulic, pneumatic actuators; drive systems; transmission mechanisms; applications in industrial robots.

Unit IV
Robot sensors; position, velocity, force sensors; vision sensors basics; sensor integration; role in robotic perception and control.

Unit V
Industrial robot applications; welding, assembly, material handling; safety standards; introduction to robot programming concepts.

Text Books

1. Groover, M. P. (2019). *Industrial Robotics*. McGraw-Hill.
2. Craig, J. J. (2018). *Introduction to Robotics: Mechanics and Control*. Pearson.
3. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2017). *Robot Modeling and Control*. Wiley.
4. Fu, K. S., Gonzalez, R. C., & Lee, C. S. G. (2016). *Robotics: Control, Sensing, Vision, and Intelligence*. McGraw-Hill.
5. Mittal, R. K., & Nagrath, I. J. (2017). *Robotics and Control*. Tata McGraw-Hill.

Reference Books

1. Asada, H., & Slotine, J. J. E. (2018). *Robot Analysis and Control*. Wiley.
2. Siciliano, B., & Khatib, O. (2016). *Springer Handbook of Robotics*. Springer.
3. McKerrow, P. J. (2017). *Introduction to Robotics*. Addison-Wesley.
4. Saeed B. Niku. (2019). *Introduction to Robotics*. Wiley.
5. Groover, M. P. (2018). *Automation, Production Systems, and CIM*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I (AI / IoT / Manufacturing Systems)

Course Category: Open Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce interdisciplinary engineering concepts
2. Provide exposure to emerging technologies
3. Enable application-oriented learning
4. Encourage cross-domain understanding
5. Support innovation and adaptability

Course Outcomes
CO1: Understand fundamentals of selected elective domain
CO2: Apply concepts in engineering contexts
CO3: Analyze technological applications
CO4: Integrate interdisciplinary knowledge
CO5: Demonstrate awareness of emerging trends

Detailed Syllabus

Unit I
Introduction to selected elective domain; scope, significance; basic concepts; engineering relevance; application overview in industrial and automation contexts.

Unit II
Core principles and architectures; system components; data flow; functional blocks; application-oriented understanding.

Unit III
Implementation aspects; tools, platforms; performance considerations; engineering constraints; case examples.

Unit IV
Integration with automation systems; industrial use cases; benefits and limitations; safety and reliability aspects.

Unit V
Future trends; challenges; sustainability considerations; role of engineers in interdisciplinary technology adoption.

Text Books

1. Selected based on elective domain syllabus.
2. Standard textbooks relevant to chosen elective area.
3. Recent publications supporting interdisciplinary learning.
4. Industry-oriented reference texts.
5. Faculty-approved academic resources.

Reference Books

1. Domain-specific reference materials.
2. Industry standards and reports.
3. Peer-reviewed books and monographs.
4. Professional society publications.
5. Faculty-recommended resources.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Mechatronics & Automation Laboratory

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Integrate mechanical, electrical, and control systems
2. Develop hands-on skills in automation experiments
3. Apply theoretical concepts in laboratory environment
4. Enhance problem-solving through practical work
5. Promote teamwork and documentation skills

Course Outcomes
CO1: Perform mechatronics experiments
CO2: Integrate sensors, actuators, and controllers
CO3: Analyze experimental results
CO4: Implement basic automation systems
CO5: Prepare structured laboratory reports

List of Experiments / Exercises

1. Identification and testing of sensors, actuators, and transducers used in mechatronic systems, focusing on characteristics, calibration methods, and signal interpretation.
2. Study and implementation of basic electrical and electronic circuits for automation, including relays, contactors, and protection devices.
3. Programming and operation of PLC for simple logic control applications, using ladder logic and industrial control scenarios.
4. Interfacing sensors and actuators with PLC systems, focusing on digital and analog input–output signal handling.
5. Speed control of DC motor using suitable control techniques, measurement of performance parameters, and analysis of results.
6. Study of pneumatic components and implementation of basic pneumatic control circuits using standard symbols and safety practices.
7. Electro-pneumatic system implementation integrating electrical control with pneumatic actuation for automation tasks.
8. Measurement and control of process variables such as temperature or level using sensors and basic controllers.
9. Study of industrial automation panels, wiring practices, safety devices, and standard operating procedures.
10. Mini integration exercise combining sensors, controllers, and actuators to realize a simple automated system.

Expected Outcomes
Practical understanding of mechatronic integration; proficiency in automation tools; ability to relate theory with practice; improved teamwork and documentation skills.

Evaluation Scheme
Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course

Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued industrial exposure
2. Strengthen practical understanding of engineering systems
3. Develop professional work culture

4. Relate academic knowledge to industry practice
5. Enhance reporting and analytical skills

Course Outcomes
CO1: Observe advanced industrial operations
CO2: Apply safety and professional standards
CO3: Relate coursework to industrial practices
CO4: Prepare structured internship documentation
CO5: Demonstrate professional responsibility

Guidelines
• Industry or research organization attachment
• Observation of automation, robotics, or manufacturing systems
• Maintenance of logbook and evaluation by industry mentor

Evaluation Scheme
Continuous Assessment (100%)

V SEMESTER

Course 1: Advanced PLC & SCADA Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Advance PLC programming skills for complex automation tasks
2. Introduce SCADA architecture and industrial supervision concepts
3. Integrate PLC systems with HMI and SCADA platforms
4. Develop understanding of industrial communication networks
5. Apply automation solutions for large-scale industrial systems

Course Outcomes
CO1: Develop advanced PLC programs for industrial processes
CO2: Explain SCADA system architecture and components
CO3: Configure HMI interfaces for monitoring and control
CO4: Integrate PLCs with industrial communication protocols
CO5: Analyze supervisory control systems in manufacturing

Detailed Syllabus

Unit I
Advanced PLC programming concepts; structured programming; function blocks; sequential function charts; interlocking logic; fault handling; optimization techniques; industrial automation requirements and scalability considerations.

Unit II
Industrial communication protocols; Modbus, Profibus, Profinet, Ethernet/IP; network topologies; data exchange; reliability; industrial networking requirements for automation and supervisory systems.

Unit III
SCADA fundamentals; architecture; hardware and software components; data acquisition; real-time monitoring; alarm management; historical data logging; engineering relevance in industrial supervision.

Unit IV
Human–Machine Interface design; screen development; trends, alarms; visualization principles; user interaction; safety considerations; integration with PLC and SCADA environments.

Unit V
SCADA applications; power systems, process industries; manufacturing automation; cybersecurity basics; system maintenance; performance analysis; case studies from industrial automation deployments.

Text Books

1. Bolton, W. (2019). *Programmable Logic Controllers*. Elsevier.
2. Boyer, S. A. (2018). *SCADA: Supervisory Control and Data Acquisition*. ISA.
3. Frank D. Petruzella. (2017). *Industrial Electronics*. McGraw-Hill.
4. Majumdar, S. R. (2018). *Industrial Automation*. Tata McGraw-Hill.
5. Clarke, G., Reynders, D., & Wright, E. (2019). *Practical Modern SCADA Protocols*. Elsevier.

Reference Books

1. Webb, J. W., & Reis, R. A. (2017). *Programmable Logic Controllers*. Pearson.
2. Mackay, S., Wright, E., Reynders, D., & Park, J. (2016). *Practical Industrial Data Networks*. Elsevier.
3. Hugh Jack. (2019). *Automating Manufacturing Systems with PLCs*. Lulu Press.
4. Alarms Management Consortium. (2018). *Alarm Management Handbook*. ISA.
5. Stouffer, K., Falco, J., & Scarfone, K. (2017). *Guide to Industrial Control Systems Security*. NIST.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Industrial Robotics & Machine Vision

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Extend robotics concepts to industrial applications
2. Introduce machine vision principles and components
3. Integrate robots with vision-based sensing
4. Analyze robotic work cells and automation tasks
5. Apply robotics solutions in manufacturing systems

Course Outcomes
CO1: Analyze industrial robot configurations and work cells
CO2: Explain robot programming methods
CO3: Understand machine vision components and lighting
CO4: Integrate vision systems with industrial robots
CO5: Apply robotics and vision in automation applications

Detailed Syllabus

Unit I
Industrial robot types; articulated, SCARA, Cartesian robots; work envelope; payload considerations; robot selection criteria; applications in manufacturing automation.

Unit II
Robot programming; teach pendant programming; offline programming concepts; motion types; path planning basics; industrial safety standards and practices.

Unit III
Machine vision fundamentals; imaging systems; cameras, lenses; lighting techniques; image acquisition; resolution and contrast considerations for industrial inspection.

Unit IV
Image processing basics; filtering, thresholding; edge detection; feature extraction; pattern recognition concepts; applications in inspection and quality control.

Unit V
Robot vision integration; vision-guided robotics; calibration; pick-and-place systems; industrial case studies; flexible manufacturing applications.

Text Books

1. Groover, M. P. (2019). *Industrial Robotics*. McGraw-Hill.
2. Craig, J. J. (2018). *Introduction to Robotics*. Pearson.
3. Jain, R. C., Kasturi, R., & Schunck, B. G. (2016). *Machine Vision*. McGraw-Hill.
4. Szeliski, R. (2022). *Computer Vision: Algorithms and Applications*. Springer.
5. Niku, S. B. (2019). *Introduction to Robotics*. Wiley.

Reference Books

1. Davies, E. R. (2018). *Computer and Machine Vision*. Academic Press.
2. Sonka, M., Hlavac, V., & Boyle, R. (2017). *Image Processing, Analysis, and Machine Vision*. Cengage.
3. Siciliano, B., & Khatib, O. (2016). *Springer Handbook of Robotics*. Springer.
4. Gonzalez, R. C., & Woods, R. E. (2018). *Digital Image Processing*. Pearson.

5. Pires, J. N. (2017). *Industrial Robots Programming*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Embedded Systems Design

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop embedded system design methodology
2. Understand hardware–software co-design concepts
3. Program microcontroller-based embedded systems
4. Interface peripherals and communication modules
5. Apply embedded systems in automation applications

Course Outcomes
CO1: Design basic embedded system architectures
CO2: Develop firmware for embedded controllers
CO3: Interface sensors and actuators
CO4: Implement communication protocols
CO5: Apply embedded systems in industrial automation

Detailed Syllabus

Unit I
Embedded systems overview; characteristics; hardware components; microcontrollers; memory organization; development tools; applications in automation and intelligent devices.

Unit II
Embedded C programming; data types; control structures; interrupts; timers; real-time constraints; firmware development practices.

Unit III
Peripheral interfacing; GPIO, ADC, DAC; timers; serial communication; UART, SPI, I2C; engineering applications in control and monitoring systems.

Unit IV
Real-time operating systems basics; task scheduling; inter-process communication; synchronization; relevance in complex embedded applications.

Unit V
Embedded system applications; industrial automation; robotics controllers; IoT device overview; reliability and safety considerations.

Text Books

1. Raj Kamal. (2018). *Embedded Systems*. McGraw-Hill.
2. Valvano, J. (2019). *Embedded Systems: Introduction to ARM Cortex-M Microcontrollers*. Cengage.
3. Simon, D. (2018). *Embedded Systems Software Primer*. Pearson.
4. Mazidi, M. A., & McKinlay, R. D. (2017). *Embedded Systems Programming*. Pearson.
5. Barr, M., & Massa, A. (2018). *Programming Embedded Systems*. O'Reilly.

Reference Books

1. Wolf, W. (2017). *Computers as Components*. Morgan Kaufmann.
2. Ganssle, J. (2019). *The Art of Designing Embedded Systems*. Newnes.
3. Noergaard, T. (2018). *Embedded Systems Architecture*. Elsevier.
4. White, E. (2016). *Making Embedded Systems*. O'Reilly.
5. Labrosse, J. J. (2017). *Embedded Systems Building Blocks*. Newnes.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Smart Sensors & Actuators

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce smart sensing technologies
2. Explain actuator types and characteristics
3. Integrate sensors and actuators with controllers
4. Apply sensing systems in automation
5. Support intelligent manufacturing applications

Course Outcomes
CO1: Identify smart sensor technologies
CO2: Analyze actuator performance characteristics

CO3: Interface sensors and actuators with control systems
CO4: Apply sensing solutions in automation systems
CO5: Evaluate sensor–actuator integration strategies

Detailed Syllabus

Unit I
Smart sensors overview; characteristics; signal conditioning; calibration; digital sensors; applications in industrial automation and robotics systems.

Unit II
Position and motion sensors; encoders; resolvers; inertial sensors; applications in motion control and robotic systems.

Unit III
Force, pressure, flow sensors; operating principles; performance parameters; industrial applications in process control.

Unit IV
Actuators; electric motors; servo motors; stepper motors; hydraulic and pneumatic actuators; selection criteria; industrial relevance.

Unit V
Sensor–actuator integration; closed-loop control; reliability; safety considerations; applications in smart manufacturing environments.

Text Books

1. Fraden, J. (2016). *Handbook of Modern Sensors*. Springer.
2. Bolton, W. (2018). *Mechatronics*. Pearson.
3. Patranabis, D. (2018). *Sensors and Transducers*. PHI Learning.
4. Webster, J. G. (2017). *Sensors and Measurement*. Wiley.
5. Bishop, R. H. (2019). *Mechatronic Systems*. CRC Press.

Reference Books

1. Figliola, R. S., & Beasley, D. E. (2018). *Theory and Design for Mechanical Measurements*. Wiley.
2. Nakra, B. C., & Chaudhry, K. K. (2018). *Instrumentation, Measurement and Analysis*. McGraw-Hill.
3. Alciatore, D., & Histand, M. (2017). *Introduction to Mechatronics and Measurement Systems*. McGraw-Hill.
4. Jamshidi, M. (2019). *Systems of Systems Engineering*. Wiley.
5. Bolton, W. (2019). *Control Engineering*. Elsevier.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I (Digital Manufacturing / AI in Automation)

Course Category: Professional Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide specialization exposure in emerging domains
2. Develop application-oriented understanding
3. Integrate digital technologies with automation
4. Promote industry-relevant skill development
5. Encourage innovation and research orientation

Course Outcomes
CO1: Understand core concepts of selected elective
CO2: Apply advanced tools and techniques
CO3: Analyze industrial use cases
CO4: Integrate elective knowledge with automation systems
CO5: Demonstrate specialization competence

Detailed Syllabus

Unit I
Overview of selected elective domain; scope; fundamentals; industrial relevance; application areas in manufacturing and automation.

Unit II
Core technologies and architectures; system components; data flow; computational frameworks; engineering significance.

Unit III
Implementation techniques; tools and platforms; performance considerations; industrial constraints.

Unit IV
Integration with automation and control systems; industrial applications; benefits and limitations.

Unit V
Emerging trends; challenges; sustainability considerations; future directions in selected specialization.

Text Books

1. Domain-specific standard textbooks.
2. Industry-oriented academic references.
3. Faculty-approved elective texts.
4. Recent publications in specialization area.
5. Professional society recommended books.

Reference Books

1. Domain-specific reference literature.
2. Research-oriented monographs.
3. Industry standards and reports.
4. Advanced academic resources.
5. Faculty-recommended materials.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project I (Robotic System Design)

Course Category: Project Course

Credits / Contact Hours: 5 Credits / 75 Contact Hours

Course Objectives

1. Apply multidisciplinary knowledge in system design
2. Develop problem identification and solution skills
3. Promote teamwork and project planning
4. Implement basic robotic or automation systems
5. Enhance technical documentation abilities

Course Outcomes
CO1: Identify and define project objectives
CO2: Design robotic or automation systems
CO3: Implement hardware or software solutions
CO4: Analyze project performance
CO5: Prepare structured technical reports

Guidelines
• Identification of problem statement
• System design and implementation
• Periodic reviews and progress evaluation
• Final demonstration and documentation

Evaluation Scheme
Continuous Assessment (100%)

VI SEMESTER

Course 1: CNC Machines & Flexible Manufacturing Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of CNC machine tools
2. Develop knowledge of CNC programming techniques
3. Analyze machining processes in automated environments
4. Introduce flexible manufacturing system concepts
5. Relate CNC and FMS to smart manufacturing

Course Outcomes
CO1: Explain CNC machine tool components and operations
CO2: Develop basic CNC part programs
CO3: Analyze CNC machining processes
CO4: Understand flexible manufacturing system architecture
CO5: Apply CNC and FMS concepts in industrial contexts

Detailed Syllabus

Unit I
Conventional and CNC machine tools; evolution of CNC; CNC machine structure; axes configuration; drives; feedback systems; advantages and limitations; relevance in automated manufacturing environments.

Unit II
CNC control systems; point to point, contouring control; interpolation techniques; coordinate systems; tool offsets; engineering interpretation of machining accuracy and precision.

Unit III
CNC programming; manual part programming; G codes, M codes; canned cycles; tool path generation; applications in milling and turning operations.

Unit IV
Flexible manufacturing systems; components; material handling systems; automated storage; computer control; system layouts; applications in batch and mass production.

Unit V
Integration of CNC and FMS; production planning; scheduling; computer integrated manufacturing overview; performance evaluation; industrial case studies.

Text Books

1. Groover, M. P. (2019). *Automation, Production Systems, and Computer-Integrated Manufacturing*. Pearson.
2. Smid, P. (2017). *CNC Programming Handbook*. Industrial Press.
3. Rao, P. N. (2018). *CAD/CAM Principles and Applications*. McGraw-Hill.
4. Zeid, I. (2016). *CAD/CAM Theory and Practice*. McGraw-Hill.
5. Chang, T. C., Wysk, R. A., & Wang, H. P. (2017). *Computer-Aided Manufacturing*. Pearson.

Reference Books

1. Raghuwanshi, B. S. (2018). *Manufacturing Processes*. Laxmi Publications.
2. Kalpakjian, S., & Schmid, S. (2018). *Manufacturing Engineering and Technology*. Pearson.
3. Jain, R. K. (2019). *Production Technology*. Khanna Publishers.
4. Groover, M. P. (2018). *Fundamentals of Modern Manufacturing*. Wiley.
5. Schey, J. A. (2017). *Introduction to Manufacturing Processes*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Industrial IoT & Cyber-Physical Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce Industrial IoT concepts and architectures
2. Understand cyber-physical system integration
3. Develop knowledge of communication protocols
4. Apply IIoT in manufacturing automation
5. Address security and data management aspects

Course Outcomes
CO1: Explain Industrial IoT system architecture
CO2: Integrate sensors and devices in IIoT systems
CO3: Apply communication protocols for IIoT

CO4: Analyze cyber-physical system behavior
CO5: Address security challenges in IIoT applications

Detailed Syllabus

Unit I
Industrial IoT overview; evolution; architecture layers; sensors, actuators; connectivity models; relevance in smart factories and intelligent manufacturing systems.

Unit II
Cyber-physical systems; definition; components; sensing, computation, control; system integration concepts; engineering significance in automation.

Unit III
Communication protocols; MQTT, OPC UA, CoAP; industrial Ethernet; data acquisition; cloud and edge computing concepts.

Unit IV
Data management; data analytics basics; real-time monitoring; predictive maintenance concepts; applications in manufacturing optimization.

Unit V
Security and reliability; cybersecurity threats; data integrity; safety considerations; standards; industrial case studies.

Text Books

1. Gilchrist, A. (2016). *Industry 4.0*. Apress.
2. Hermann, M., Pentek, T., & Otto, B. (2016). *Design Principles for Industrie 4.0 Scenarios*. Springer.
3. Rajkumar, R., et al. (2018). *Cyber-Physical Systems*. CRC Press.
4. Al-Fuqaha, A. (2018). *Internet of Things*. Morgan Kaufmann.
5. Bahga, A., & Madisetti, V. (2017). *Internet of Things: A Hands-On Approach*. Universities Press.

Reference Books

1. Lee, J., Bagheri, B., & Kao, H. A. (2016). *Cyber-Physical Systems Architecture*. Manufacturing Letters.
2. Xu, L. D., He, W., & Li, S. (2017). *Internet of Things in Industries*. IEEE.
3. Stankovic, J. A. (2017). *Research Directions for the Internet of Things*. IEEE.
4. Minoli, D. (2019). *Building the Internet of Things*. Wiley.
5. Gubbi, J. (2018). *Internet of Things*. Elsevier.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Motion Control & Servo Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of motion control systems
2. Explain servo motor characteristics and control
3. Analyze feedback systems for motion control
4. Apply motion control in automation applications
5. Integrate drives and controllers for precision systems

Course Outcomes
CO1: Explain motion control system components
CO2: Analyze servo motor performance
CO3: Design basic motion control loops
CO4: Apply feedback principles in motion systems
CO5: Integrate motion control in automation equipment

Detailed Syllabus

Unit I
Motion control fundamentals; open loop, closed loop systems; position, velocity, torque control; applications in automation and robotics.

Unit II
Servo motors; DC servo, AC servo motors; characteristics; selection criteria; industrial applications.

Unit III
Drives and amplifiers; power electronic drives; control modes; tuning concepts; performance evaluation.

Unit IV
Feedback devices; encoders, resolvers; sensors; signal processing; accuracy and resolution considerations.

Unit V
Motion controllers; multi-axis control; trajectory planning; synchronization; applications in CNC, robotics, and automation systems.

Text Books

1. Bolton, W. (2018). *Control Engineering*. Elsevier.
2. Hughes, A. (2017). *Electric Motors and Drives*. Elsevier.
3. Leonhard, W. (2016). *Control of Electrical Drives*. Springer.
4. Bose, B. K. (2018). *Modern Power Electronics and AC Drives*. Pearson.
5. Kenjo, T., & Sugawara, A. (2017). *Stepping Motors and Their Microprocessor Controls*. Oxford.

Reference Books

1. Dorf, R. C., & Bishop, R. H. (2017). *Modern Control Systems*. Pearson.
2. Sen, P. C. (2018). *Principles of Electric Machines and Power Electronics*. Wiley.
3. Krishnan, R. (2017). *Electric Motor Drives*. Pearson.
4. Ogata, K. (2018). *Modern Control Engineering*. Pearson.
5. Chapman, S. J. (2016). *Electric Machinery Fundamentals*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Human–Machine Interface & Safety Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce human–machine interface concepts
2. Develop HMI design understanding
3. Explain industrial safety standards
4. Integrate safety systems in automation
5. Promote ergonomic and safe system design

Course Outcomes
CO1: Design basic HMI screens
CO2: Explain human factors in system design
CO3: Apply industrial safety standards
CO4: Integrate safety devices in automation systems
CO5: Evaluate ergonomic considerations

Detailed Syllabus

Unit I
Human–machine interface fundamentals; role of HMI; interface components; visualization principles; applications in industrial automation.

Unit II
HMI design principles; screen layouts; alarms, trends; color coding; usability; ergonomic considerations.

Unit III
Industrial safety fundamentals; hazards; risk assessment; safety life cycle; standards overview.

Unit IV
Safety devices; emergency stops; safety relays; light curtains; interlocks; integration in automation systems.

Unit V
Functional safety; SIL concepts; safety PLCs; safety validation; applications in manufacturing and process industries.

Text Books

1. Sanders, M. S., & McCormick, E. J. (2018). *Human Factors in Engineering and Design*. McGraw-Hill.
2. Boyer, S. A. (2018). *SCADA: Supervisory Control and Data Acquisition*. ISA.
3. Manuele, F. A. (2017). *Advanced Safety Management*. Wiley.
4. Reason, J. (2016). *Managing the Risks of Organizational Accidents*. Ashgate.
5. IEC. (2018). *Functional Safety Standards*. IEC Publications.

Reference Books

1. Salvendy, G. (2017). *Handbook of Human Factors*. Wiley.
2. OSHA. (2018). *Industrial Safety Standards*. OSHA Publications.
3. ISO. (2017). *Safety of Machinery*. ISO Standards.
4. Dul, J., & Weerdmeester, B. (2016). *Ergonomics for Beginners*. CRC Press.
5. Kletz, T. (2018). *Hazop and Hazan*. IChemE.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II (Smart Factories / Industry 5.0)

Course Category: Open Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce advanced manufacturing paradigms
2. Understand smart factory concepts
3. Integrate human-centric automation principles
4. Analyze sustainability and resilience aspects
5. Explore future manufacturing trends

Course Outcomes
CO1: Explain smart factory architectures
CO2: Apply Industry 5.0 principles
CO3: Analyze human–machine collaboration
CO4: Evaluate sustainability in manufacturing
CO5: Interpret future industrial trends

Detailed Syllabus

Unit I
Smart factories overview; digital manufacturing; cyber-physical integration; engineering relevance in modern production systems.

Unit II
Industry 5.0 concepts; human-centric automation; resilience; sustainability; collaborative systems.

Unit III
Technologies enabling smart factories; AI, robotics, IoT; data-driven manufacturing.

Unit IV
Human–robot collaboration; cobots; safety and ergonomics; applications in flexible manufacturing.

Unit V
Future trends; challenges; policy and standardization; role of engineers in next-generation manufacturing.

Text Books

1. Breque, M., De Nul, L., & Petridis, A. (2021). *Industry 5.0*. European Commission.
2. Gilchrist, A. (2016). *Industry 4.0*. Apress.
3. Kagermann, H. (2017). *Industrie 4.0 in a Global Context*. Herbert Utz.

4. Xu, L. D. (2018). *Enterprise Integration and Information Architecture*. CRC Press.
5. Groover, M. P. (2019). *Automation, Production Systems*. Pearson.

Reference Books

1. Lee, J. (2018). *Industrial AI*. Springer.
2. Schuh, G. (2020). *Designing the Digital Factory*. Springer.
3. Monostori, L. (2018). *Cyber-Physical Production Systems*. CIRP.
4. Romero, D. (2020). *Towards Industry 5.0*. Springer.
5. Porter, M. E. (2019). *Competitive Advantage*. Free Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project II (Prototype Development)

Course Category: Project Course

Credits / Contact Hours: 5 Credits / 75 Contact Hours

Course Objectives

1. Develop functional prototype based on prior design
2. Apply engineering tools for implementation
3. Validate system performance
4. Enhance teamwork and project management
5. Prepare for major project work

Course Outcomes
CO1: Implement functional prototypes
CO2: Integrate hardware and software components
CO3: Test and validate system performance
CO4: Document project work systematically
CO5: Demonstrate readiness for advanced projects

Guidelines
• Prototype fabrication and integration
• Periodic design reviews
• Testing, validation, and refinement
• Final demonstration and technical documentation

Evaluation Scheme
Continuous Assessment (100%)

VII SEMESTER

Course 1: Smart Manufacturing & Industry 5.0

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand evolution of manufacturing paradigms toward Industry 5.0
2. Integrate human-centric, sustainable manufacturing principles
3. Apply digital technologies in smart manufacturing systems
4. Analyze resilience and adaptability of production systems
5. Prepare for next-generation industrial transformation

Course Outcomes
CO1: Explain smart manufacturing architectures
CO2: Interpret Industry 5.0 principles and drivers
CO3: Analyze human–machine collaboration models
CO4: Apply sustainability concepts in manufacturing systems
CO5: Evaluate resilience and adaptability in production environments

Detailed Syllabus

Unit I
Manufacturing evolution; Industry 1.0 to Industry 5.0; smart manufacturing concepts; cyber-physical production systems; digitalization; connectivity; relevance to modern industrial ecosystems and competitive manufacturing environments.

Unit II
Industry 5.0 principles; human-centricity; resilience; sustainability; ethical manufacturing; social responsibility; integration of humans with intelligent automation systems in advanced production environments.

Unit III
Enabling technologies; artificial intelligence; industrial robotics; industrial IoT; digital twins; data-driven manufacturing; integration frameworks for smart production systems.

Unit IV
Human–robot collaboration; collaborative robots; safety standards; ergonomic design; skill augmentation; adaptive workstations; applications in flexible and customized manufacturing.

Unit V
Smart manufacturing implementation; challenges; standardization; policy perspectives; future

trends; role of engineers in designing resilient, sustainable, and intelligent manufacturing systems.

Text Books

1. Groover, M. P. (2019). *Automation, Production Systems, and Computer-Integrated Manufacturing*. Pearson.
2. Breque, M., De Nul, L., & Petridis, A. (2021). *Industry 5.0*. European Commission.
3. Kagermann, H. (2017). *Industrie 4.0 in a Global Context*. Herbert Utz.
4. Xu, L. D. (2018). *Enterprise Integration and Information Architecture*. CRC Press.
5. Gilchrist, A. (2016). *Industry 4.0*. Apress.

Reference Books

1. Monostori, L. (2018). *Cyber-Physical Production Systems*. CIRP.
2. Romero, D. (2020). *Towards Industry 5.0*. Springer.
3. Schuh, G. (2020). *Designing the Digital Factory*. Springer.
4. Lee, J. (2018). *Industrial AI*. Springer.
5. Porter, M. E. (2019). *Competitive Advantage*. Free Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Autonomous Robots & Mobile Robotics

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce autonomous robot architectures
2. Develop understanding of mobile robot kinematics
3. Explain localization and navigation principles
4. Integrate perception and control for autonomy
5. Apply mobile robotics in real-world environments

Course Outcomes
CO1: Explain autonomous robot system architectures
CO2: Analyze kinematics of mobile robots
CO3: Apply localization and mapping techniques

CO4: Design basic navigation and path planning algorithms
CO5: Evaluate autonomous robot applications

Detailed Syllabus

Unit I
Autonomous robotics overview; levels of autonomy; mobile robot types; wheeled, tracked, legged robots; applications in industrial, service, and field robotics environments.

Unit II
Mobile robot kinematics; differential drive, Ackermann steering; motion models; constraints; odometry; engineering interpretation of robot motion behavior.

Unit III
Perception systems; range sensors; lidar, ultrasonic, vision sensors; sensor fusion basics; environment representation for autonomous navigation.

Unit IV
Localization and mapping; probabilistic localization; SLAM concepts; map representations; engineering relevance in unknown and dynamic environments.

Unit V
Navigation and control; path planning; obstacle avoidance; behavior-based control; applications in logistics, warehouses, autonomous vehicles, and service robots.

Text Books

1. Siegwart, R., Nourbakhsh, I. R., & Scaramuzza, D. (2017). *Introduction to Autonomous Mobile Robots*. MIT Press.
2. Thrun, S., Burgard, W., & Fox, D. (2016). *Probabilistic Robotics*. MIT Press.
3. Dudek, G., & Jenkin, M. (2018). *Computational Principles of Mobile Robotics*. Cambridge.
4. LaValle, S. M. (2017). *Planning Algorithms*. Cambridge.
5. Niku, S. B. (2019). *Introduction to Robotics*. Wiley.

Reference Books

1. Siciliano, B., & Khatib, O. (2016). *Springer Handbook of Robotics*. Springer.
2. Corke, P. (2017). *Robotics, Vision and Control*. Springer.
3. Borenstein, J. (2016). *Mobile Robot Positioning*. IEEE Press.
4. Arkin, R. C. (2018). *Behavior-Based Robotics*. MIT Press.
5. Lynch, K. M., & Park, F. C. (2017). *Modern Robotics*. Cambridge.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Artificial Intelligence & Machine Learning for Automation

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce artificial intelligence concepts for automation
2. Explain machine learning algorithms and workflows
3. Apply AI techniques in industrial automation
4. Analyze data-driven decision-making systems
5. Prepare for intelligent manufacturing applications

Course Outcomes
CO1: Explain AI and ML fundamentals
CO2: Apply supervised and unsupervised learning techniques
CO3: Analyze industrial data using ML models
CO4: Integrate AI with automation systems
CO5: Evaluate AI-driven automation solutions

Detailed Syllabus

Unit I
Artificial intelligence overview; problem types; knowledge representation; search strategies; relevance of AI in automation and intelligent manufacturing systems.

Unit II
Machine learning fundamentals; supervised learning; regression, classification; model training; validation; engineering interpretation of learning performance.

Unit III
Unsupervised learning; clustering; dimensionality reduction; feature extraction; applications in process optimization and anomaly detection.

Unit IV
Neural networks; deep learning basics; training concepts; industrial applications; predictive maintenance and quality inspection.

Unit V
AI integration in automation; decision support systems; ethical considerations; deployment challenges; future trends in intelligent automation.

Text Books

1. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach*. Pearson.

2. Bishop, C. M. (2016). *Pattern Recognition and Machine Learning*. Springer.
3. Goodfellow, I., Bengio, Y., & Courville, A. (2017). *Deep Learning*. MIT Press.
4. Mitchell, T. M. (2017). *Machine Learning*. McGraw-Hill.
5. Alpaydin, E. (2020). *Introduction to Machine Learning*. MIT Press.

Reference Books

1. Murphy, K. P. (2018). *Machine Learning: A Probabilistic Perspective*. MIT Press.
2. Géron, A. (2019). *Hands-On Machine Learning*. O'Reilly.
3. Shalev-Shwartz, S., & Ben-David, S. (2017). *Understanding Machine Learning*. Cambridge.
4. Domingos, P. (2016). *The Master Algorithm*. Basic Books.
5. Jordan, M. I. (2019). *Artificial Intelligence and Machine Learning*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Twins & Simulation Technologies

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce digital twin concepts and frameworks
2. Apply simulation techniques for system modeling
3. Integrate physical and virtual system representations
4. Analyze performance using digital twins
5. Support predictive and optimization-based decision making

Course Outcomes
CO1: Explain digital twin architectures
CO2: Develop simulation models of engineering systems
CO3: Integrate real-time data with simulation models
CO4: Analyze system behavior using digital twins
CO5: Apply digital twins in industrial contexts

Detailed Syllabus

Unit I
Digital twins overview; definitions; evolution; components; physical–virtual integration; relevance in smart manufacturing and intelligent systems.

Unit II
Modeling and simulation fundamentals; mathematical models; discrete event simulation; continuous simulation; engineering interpretation of system behavior.

Unit III
Simulation tools; CAD–CAE integration; system-level simulation; validation and verification techniques; accuracy considerations.

Unit IV
Real-time data integration; sensors; IoT connectivity; synchronization; applications in monitoring, diagnostics, and optimization.

Unit V
Industrial applications; predictive maintenance; process optimization; challenges; scalability; future trends in digital twin technology.

Text Books

1. Tao, F., Zhang, H., Liu, A., & Nee, A. Y. C. (2018). *Digital Twin Driven Smart Manufacturing*. Academic Press.
2. Banks, J., Carson, J. S., Nelson, B. L., & Nicol, D. M. (2019). *Discrete-Event System Simulation*. Pearson.
3. Zeigler, B. P. (2018). *Theory of Modeling and Simulation*. Academic Press.
4. Groover, M. P. (2019). *Automation, Production Systems*. Pearson.
5. Boschert, S., & Rosen, R. (2016). *Digital Twin*. Springer.

Reference Books

1. Tuegel, E. J. (2018). *Digital Twin: Modeling and Simulation*. AIAA.
2. Jain, S. (2017). *Simulation Modeling Using FlexSim*. Academic Press.
3. Law, A. M. (2018). *Simulation Modeling and Analysis*. McGraw-Hill.
4. Negri, E. (2017). *A Review of Digital Twin Applications*. CIRP.
5. Grieves, M. (2019). *Digital Twin: Manufacturing Excellence*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective II (Healthcare / Agricultural / Defence Robotics)

Course Category: Professional Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide domain-specific robotics specialization
2. Apply robotics technologies in societal sectors
3. Integrate automation with domain constraints
4. Analyze sector-specific challenges
5. Promote application-oriented innovation

Course Outcomes
CO1: Understand robotics applications in selected sector
CO2: Analyze domain-specific system requirements
CO3: Apply robotics solutions to real problems
CO4: Integrate sensors, actuators, and control systems
CO5: Evaluate impact and feasibility of robotic systems

Detailed Syllabus

Unit I
Overview of selected domain; healthcare, agricultural, defence robotics; scope; challenges; engineering relevance.

Unit II
System architectures; sensors; actuators; control strategies; safety considerations specific to domain applications.

Unit III
Autonomy and intelligence requirements; perception; decision making; human interaction aspects.

Unit IV
Case studies; deployed systems; performance analysis; regulatory and ethical considerations.

Unit V
Future directions; innovation opportunities; research challenges; role of robotics engineers in selected domains.

Text Books

1. Domain-specific standard textbooks.
2. Faculty-approved specialization texts.
3. Recent academic publications.

4. Industry and government reports.
5. Professional society references.

Reference Books

1. Sector-specific reference literature.
2. Research monographs.
3. Industry standards.
4. Advanced academic resources.
5. Faculty-recommended materials.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Semester Internship (Industry / Research Lab)

Course Category: Internship / Industrial Training Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Provide in-depth industrial or research exposure
2. Apply advanced engineering knowledge in practice
3. Develop research or professional competencies
4. Strengthen problem-solving and analytical skills
5. Enhance industry or research readiness

Course Outcomes
CO1: Perform assigned industrial or research tasks
CO2: Apply theoretical knowledge to real problems
CO3: Demonstrate professional ethics and discipline
CO4: Prepare structured technical or research reports
CO5: Present internship outcomes effectively

Guidelines
• Full-time internship in industry or research laboratory
• Defined objectives and mentor supervision
• Periodic evaluation and final assessment

Evaluation Scheme
Continuous Assessment (100%)

Course 7: Major Project Phase I

Course Category: Project Course

Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Identify major project problem area
2. Conduct literature review and requirement analysis
3. Define project methodology and planning
4. Establish feasibility and objectives
5. Prepare for implementation phase

Course Outcomes
CO1: Identify and justify project topic
CO2: Perform literature survey
CO3: Define project objectives and methodology
CO4: Prepare project proposal documentation
CO5: Demonstrate readiness for execution

Guidelines
• Problem identification and proposal submission
• Literature review and requirement analysis
• Periodic reviews and presentations

Evaluation Scheme
Continuous Assessment (100%)

VIII SEMESTER SYLLABUS

Course 1: Maintenance Engineering & Reliability

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of maintenance engineering and asset management
2. Analyze reliability concepts for engineering systems
3. Apply maintenance strategies in industrial environments
4. Integrate reliability engineering with automation systems
5. Improve system availability, safety, and lifecycle performance

Course Outcomes
CO1: Explain maintenance philosophies and strategies
CO2: Analyze reliability and failure characteristics
CO3: Apply maintenance planning techniques
CO4: Use reliability tools for system evaluation
CO5: Improve availability and lifecycle performance

Detailed Syllabus

Unit I
Maintenance concepts; breakdown, preventive, predictive maintenance; maintenance organization; planning and scheduling; maintenance documentation; relevance in automated manufacturing and industrial asset management systems.

Unit II
Reliability fundamentals; failure modes; bathtub curve; failure rate; mean time between failures; reliability functions; engineering interpretation of system dependability and performance.

Unit III
Maintainability and availability; repair time distributions; availability analysis; redundancy concepts; reliability block diagrams; applications in industrial systems and automation facilities.

Unit IV
Condition monitoring techniques; vibration analysis; thermography; oil analysis; non-destructive testing basics; predictive maintenance applications in automated plants.

Unit V
Reliability engineering tools; FMEA, FTA; risk assessment; lifecycle costing; maintenance optimization; industrial case studies in manufacturing and process industries.

Text Books

1. Dhillon, B. S. (2018). *Engineering Maintenance*. CRC Press.
2. Ebeling, C. E. (2017). *An Introduction to Reliability and Maintainability Engineering*. McGraw-Hill.
3. Smith, A. M., & Hinchcliffe, G. R. (2016). *RCM—Gateway to World Class Maintenance*. Elsevier.
4. Moubray, J. (2018). *Reliability-Centered Maintenance*. Butterworth-Heinemann.
5. Kuo, W., & Zuo, M. J. (2017). *Optimal Reliability Modeling*. Wiley.

Reference Books

1. Modarres, M. (2017). *Risk Analysis in Engineering*. CRC Press.
2. Blanchard, B. S., & Fabrycky, W. J. (2018). *Systems Engineering and Analysis*. Pearson.
3. Jardine, A. K. S., & Tsang, A. H. C. (2019). *Maintenance, Replacement, and Reliability*. CRC Press.
4. O'Connor, P. (2016). *Practical Reliability Engineering*. Wiley.
5. IEC. (2017). *Dependability Management Standards*. IEC Publications.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Advanced Manufacturing Analytics

Course Category: Core Engineering Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce data analytics concepts for manufacturing
2. Apply statistical and analytical tools to production data
3. Integrate analytics with smart manufacturing systems
4. Support data-driven decision making
5. Enable performance optimization and quality improvement

Course Outcomes
CO1: Explain manufacturing analytics frameworks
CO2: Apply data analysis techniques to manufacturing data
CO3: Use analytics for quality and productivity improvement
CO4: Integrate analytics with digital manufacturing systems
CO5: Interpret analytical results for decision making

Detailed Syllabus

Unit I
Manufacturing data sources; sensors; production data; data acquisition systems; data quality; relevance of analytics in modern manufacturing environments.

Unit II
Statistical process control; control charts; process capability analysis; quality metrics; applications in production monitoring and quality assurance.

Unit III
Descriptive and predictive analytics; regression models; trend analysis; anomaly detection; applications in predictive maintenance and yield improvement.

Unit IV
Advanced analytics; machine learning basics; classification, clustering; applications in manufacturing optimization and intelligent decision support.

Unit V
Manufacturing analytics platforms; integration with MES, ERP systems; visualization dashboards; challenges; future trends in industrial analytics.

Text Books

1. Montgomery, D. C. (2019). *Introduction to Statistical Quality Control*. Wiley.
2. Choudhary, A., Harding, J., & Tiwari, M. K. (2019). *Data Mining in Manufacturing*. Springer.
3. Groover, M. P. (2019). *Automation, Production Systems*. Pearson.
4. Provost, F., & Fawcett, T. (2016). *Data Science for Business*. O'Reilly.
5. Witten, I. H., Frank, E., & Hall, M. A. (2017). *Data Mining*. Morgan Kaufmann.

Reference Books

1. Han, J., Kamber, M., & Pei, J. (2018). *Data Mining: Concepts and Techniques*. Morgan Kaufmann.
2. Davenport, T. H., & Harris, J. G. (2017). *Competing on Analytics*. Harvard Business School Press.
3. Jain, A. K. (2018). *Statistical Learning*. Springer.

4. Shmueli, G. (2017). *Practical Time Series Forecasting*. Axelrod Schnall.
5. Lee, J. (2018). *Industrial AI*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective III (Additive Manufacturing / Collaborative Robots)

Course Category: Professional Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide advanced specialization exposure
2. Introduce emerging manufacturing or robotics technologies
3. Integrate elective knowledge with automation systems
4. Analyze industrial applications and challenges
5. Promote innovation and research orientation

Course Outcomes
CO1: Explain core principles of selected elective
CO2: Analyze process or system architectures
CO3: Apply elective technologies in engineering contexts
CO4: Evaluate industrial applications and constraints
CO5: Demonstrate specialization competence

Detailed Syllabus

Unit I
Overview of selected elective; additive manufacturing or collaborative robotics; scope; significance; industrial relevance and application areas.

Unit II
Core technologies; processes; system components; materials or human–robot interaction concepts; engineering considerations.

Unit III
Design considerations; process parameters; performance metrics; quality and safety aspects.

Unit IV
Industrial applications; case studies; integration with manufacturing or automation systems.

Unit V
Future trends; challenges; sustainability aspects; research opportunities in selected elective domain.

Text Books

1. Gibson, I., Rosen, D. W., & Stucker, B. (2018). *Additive Manufacturing Technologies*. Springer.
2. ISO. (2016). *Additive Manufacturing Standards*. ISO Publications.
3. Siciliano, B., & Khatib, O. (2016). *Springer Handbook of Robotics*. Springer.
4. Peshkin, M., & Colgate, J. E. (2017). *Collaborative Robots*. CRC Press.
5. Groover, M. P. (2019). *Automation, Production Systems*. Pearson.

Reference Books

1. Chua, C. K., Leong, K. F., & Lim, C. S. (2018). *Rapid Prototyping*. World Scientific.
2. Bogue, R. (2018). *Collaborative Robots*. Industrial Robot Journal.
3. Gebhardt, A. (2016). *Understanding Additive Manufacturing*. Hanser.
4. Villani, V. (2018). *Human–Robot Collaboration*. Springer.
5. Thompson, M. K. (2016). *Design for Additive Manufacturing*. Elsevier.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective III (Interdisciplinary)

Course Category: Open Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Enable interdisciplinary learning exposure
2. Apply knowledge across engineering domains
3. Encourage innovation through cross-disciplinary integration
4. Develop adaptability to emerging fields
5. Support holistic engineering education

Course Outcomes
CO1: Understand fundamentals of selected interdisciplinary domain
CO2: Apply interdisciplinary concepts in engineering contexts
CO3: Integrate knowledge from multiple disciplines
CO4: Analyze cross-domain applications
CO5: Demonstrate interdisciplinary problem-solving ability

Detailed Syllabus

Unit I
Introduction to selected interdisciplinary domain; scope; relevance; foundational concepts and engineering applications.

Unit II
Core principles and tools; methodologies; system perspectives; application-oriented understanding.

Unit III
Integration aspects; interaction with automation, robotics, or manufacturing systems; case examples.

Unit IV
Societal, ethical, and sustainability considerations; impact analysis.

Unit V
Future directions; research opportunities; role of interdisciplinary engineers.

Text Books

1. Domain-specific standard textbooks.
2. Faculty-approved interdisciplinary references.
3. Recent academic publications.
4. Professional society materials.
5. Industry-oriented texts.

Reference Books

1. Interdisciplinary reference literature.
2. Research monographs.
3. Industry standards.
4. Advanced academic resources.
5. Faculty-recommended materials.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project Phase II

Course Category: Project Course

Credits / Contact Hours: 8 Credits / 120 Contact Hours

Course Objectives

1. Implement and complete major project work
2. Apply advanced engineering knowledge
3. Validate system design and performance
4. Develop professional documentation and presentation skills
5. Demonstrate innovation and problem-solving ability

Course Outcomes
CO1: Implement complete project solution
CO2: Integrate hardware, software, and systems
CO3: Validate performance against objectives
CO4: Prepare comprehensive project documentation
CO5: Present and defend project outcomes

Guidelines
• System implementation and testing
• Periodic reviews and mentor guidance
• Final report submission and demonstration

Evaluation Scheme
Continuous Assessment (100%)

IX SEMESTER

Course 1: Advanced Robotics & Intelligent Systems

Course Category: Core Engineering Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced understanding of robotic system modeling
2. Integrate intelligence and autonomy in robotic systems
3. Analyze advanced perception and decision-making techniques
4. Apply intelligent control strategies for robotics
5. Prepare for research and advanced industrial robotics applications

Course Outcomes
CO1: Analyze advanced robotic kinematics and dynamics
CO2: Apply intelligent algorithms in robotic systems
CO3: Integrate perception, planning, and control
CO4: Evaluate autonomous robotic behaviors
CO5: Design intelligent robotic system architectures

Detailed Syllabus

Unit I
Advanced robot kinematics; differential kinematics; Jacobian matrices; singularities; redundancy resolution; workspace analysis; engineering relevance in high degree-of-freedom manipulators and advanced robotic motion control systems.

Unit II
Robot dynamics; Newton–Euler formulation; Lagrangian methods; dynamic modeling; inverse dynamics; parameter identification; relevance in high-performance robotic control and real-time motion execution.

Unit III
Intelligent control; fuzzy logic control; neural network control; adaptive control concepts; learning-based control strategies; applications in uncertain and nonlinear robotic environments.

Unit IV
Robotic perception; sensor fusion; probabilistic perception models; vision-based perception; environment understanding; relevance in autonomous navigation and manipulation tasks.

Unit V
Intelligent robotic systems; autonomy levels; deliberative and reactive architectures; multi-

robot systems; cooperation and coordination; applications in industrial, service, and field robotics domains.

Text Books

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2017). *Robot Modeling and Control*. Wiley.
2. Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2016). *Robotics: Modelling, Planning and Control*. Springer.
3. Craig, J. J. (2018). *Introduction to Robotics: Mechanics and Control*. Pearson.
4. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach*. Pearson.
5. Niku, S. B. (2019). *Introduction to Robotics*. Wiley.

Reference Books

1. Asada, H., & Slotine, J. J. E. (2018). *Robot Analysis and Control*. Wiley.
2. Lynch, K. M., & Park, F. C. (2017). *Modern Robotics*. Cambridge.
3. Thrun, S., Burgard, W., & Fox, D. (2016). *Probabilistic Robotics*. MIT Press.
4. Arkin, R. C. (2018). *Behavior-Based Robotics*. MIT Press.
5. Corke, P. (2017). *Robotics, Vision and Control*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Advanced Control Systems & Optimization

Course Category: Core Engineering Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Extend classical control concepts to advanced control strategies
2. Introduce state-space and modern control techniques
3. Apply optimization methods in control system design
4. Analyze robustness and optimality of control systems
5. Prepare for advanced research and industrial control applications

Course Outcomes
CO1: Apply state-space modeling techniques
CO2: Analyze controllability and observability

CO3: Design optimal control systems
CO4: Apply optimization methods in control problems
CO5: Evaluate robustness of advanced control systems

Detailed Syllabus

Unit I
State-space representation; state variables; state equations; transfer function to state model conversion; physical system modeling; engineering interpretation in multi-input multi-output systems.

Unit II
System properties; controllability; observability; state transition matrix; canonical forms; realization concepts; relevance in system design and analysis.

Unit III
Optimal control; performance indices; calculus of variations; linear quadratic regulator; Riccati equation; applications in precision motion and energy-efficient control systems.

Unit IV
Nonlinear control overview; linearization; phase plane analysis; Lyapunov stability concepts; engineering interpretation for nonlinear and uncertain systems.

Unit V
Optimization techniques; constrained and unconstrained optimization; gradient-based methods; evolutionary algorithms overview; applications in control parameter tuning and system optimization.

Text Books

1. Ogata, K. (2018). *Modern Control Engineering*. Pearson.
2. Kirk, D. E. (2016). *Optimal Control Theory*. Dover Publications.
3. Dorf, R. C., & Bishop, R. H. (2017). *Modern Control Systems*. Pearson.
4. Bryson, A. E., & Ho, Y. C. (2018). *Applied Optimal Control*. Taylor & Francis.
5. Khalil, H. K. (2017). *Nonlinear Systems*. Pearson.

Reference Books

1. Franklin, G. F., Powell, J. D., & Emami-Naeini, A. (2019). *Feedback Control of Dynamic Systems*. Pearson.
2. Slotine, J. J. E., & Li, W. (2017). *Applied Nonlinear Control*. Pearson.
3. Bertsekas, D. P. (2016). *Nonlinear Programming*. Athena Scientific.
4. Boyd, S., & Vandenberghe, L. (2018). *Convex Optimization*. Cambridge.
5. Åström, K. J., & Murray, R. M. (2016). *Feedback Systems*. Princeton.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Research Methodology & Technical Writing

Course Category: Humanities & Management Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce research processes and methodologies
2. Develop skills in technical writing and documentation
3. Understand research ethics and publication practices
4. Apply statistical and analytical tools in research
5. Prepare for postgraduate research and thesis work

Course Outcomes
CO1: Formulate research problems and objectives
CO2: Select appropriate research methodologies
CO3: Apply technical writing standards
CO4: Understand research ethics and plagiarism issues
CO5: Prepare research proposals and reports

Detailed Syllabus

Unit I
Research fundamentals; types of research; problem identification; literature review methods; research gaps; engineering research perspectives and significance.

Unit II
Research design; qualitative and quantitative methods; experimental design; data collection techniques; sampling methods; engineering research applications.

Unit III
Data analysis; statistical tools; hypothesis testing; interpretation of results; validity and reliability considerations in engineering research.

Unit IV
Technical writing; structure of research papers; thesis and dissertations; referencing styles; APA standards; clarity, coherence, and precision.

Unit V
Research ethics; intellectual property; plagiarism; peer review process; publication ethics; research dissemination and academic integrity.

Text Books

1. Kothari, C. R. (2019). *Research Methodology*. New Age International.
2. Day, R. A., & Gastel, B. (2017). *How to Write and Publish a Scientific Paper*. Cambridge.
3. Creswell, J. W. (2018). *Research Design*. Sage.
4. Booth, W. C., Colomb, G. G., & Williams, J. M. (2016). *The Craft of Research*. University of Chicago Press.
5. Alley, M. (2018). *The Craft of Scientific Writing*. Springer.

Reference Books

1. Montgomery, D. C. (2019). *Design and Analysis of Experiments*. Wiley.
2. IEEE. (2017). *IEEE Editorial Style Manual*. IEEE.
3. APA. (2020). *Publication Manual of the American Psychological Association*. APA.
4. Zobel, J. (2017). *Writing for Computer Science*. Springer.
5. Hofmann, A. H. (2017). *Scientific Writing and Communication*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective IV (AI-driven Manufacturing / Autonomous Systems)

Course Category: Professional Elective Course

Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide advanced specialization in intelligent systems
2. Apply AI techniques in manufacturing or autonomous platforms
3. Integrate learning-based models with engineering systems
4. Analyze real-world industrial applications
5. Encourage research-oriented and innovative thinking

Course Outcomes
CO1: Explain advanced concepts of selected elective
CO2: Apply AI techniques in engineering applications
CO3: Analyze industrial use cases and system performance
CO4: Integrate AI models with automation systems
CO5: Evaluate future trends in intelligent systems

Detailed Syllabus

Unit I
Overview of selected elective domain; AI-driven manufacturing or autonomous systems; scope; system architectures; engineering relevance and applications.

Unit II
Core algorithms; learning models; decision-making frameworks; perception and control integration; computational considerations.

Unit III
Implementation aspects; data requirements; training and validation; deployment challenges; industrial constraints.

Unit IV
Industrial applications; case studies; performance evaluation; ethical and safety considerations.

Unit V
Emerging trends; research challenges; sustainability; future directions in intelligent and autonomous systems engineering.

Text Books

1. Lee, J. (2018). *Industrial AI*. Springer.
2. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach*. Pearson.
3. Goodfellow, I., Bengio, Y., & Courville, A. (2017). *Deep Learning*. MIT Press.
4. Groover, M. P. (2019). *Automation, Production Systems*. Pearson.
5. Alpaydin, E. (2020). *Introduction to Machine Learning*. MIT Press.

Reference Books

1. Murphy, K. P. (2018). *Machine Learning: A Probabilistic Perspective*. MIT Press.
2. Géron, A. (2019). *Hands-On Machine Learning*. O'Reilly.
3. Domingos, P. (2016). *The Master Algorithm*. Basic Books.
4. Jordan, M. I. (2019). *Artificial Intelligence and Machine Learning*. Springer.
5. Xu, L. D. (2018). *Enterprise Integration*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Industry-Aligned Project / Internship

Course Category: Internship / Industrial Training Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply advanced engineering knowledge in industry or research settings
2. Solve real-world problems through project or internship work
3. Develop professional and research competencies
4. Integrate theory with industrial or research practice
5. Prepare for final integrated project

Course Outcomes
CO1: Execute industry-aligned or research-based tasks
CO2: Apply advanced tools and methodologies
CO3: Demonstrate professional ethics and discipline
CO4: Prepare comprehensive technical documentation
CO5: Present project or internship outcomes

Guidelines
• Industry or research-based project or internship
• Defined objectives with mentor supervision
• Periodic reviews and final evaluation

Evaluation Scheme
Continuous Assessment (100%)

Course 6: Seminar

Course Category: Humanities & Management Course

Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical presentation skills
2. Review and analyze recent research literature
3. Enhance critical thinking and communication
4. Prepare for research and professional discussions
5. Promote lifelong learning and academic rigor

Course Outcomes
CO1: Review and summarize technical literature
CO2: Present seminar topics effectively
CO3: Critically analyze research work
CO4: Respond to technical queries confidently
CO5: Demonstrate professional presentation skills

Guidelines
• Selection of advanced topic in robotics, automation, or manufacturing
• Literature survey and seminar report
• Oral presentation and evaluation by committee

Evaluation Scheme
Continuous Assessment (100%)

X SEMESTER

Course 1: Intellectual Property Rights & Technology Entrepreneurship

Course Category: Humanities & Management Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Create awareness of intellectual property systems and protection mechanisms
2. Understand patents, copyrights, trademarks, and industrial designs
3. Introduce technology commercialization and entrepreneurship concepts
4. Develop startup, innovation, and business planning perspectives
5. Promote ethical, legal, and sustainable technology deployment

Course Outcomes
CO1: Explain types and scope of intellectual property rights
CO2: Interpret patent filing and prosecution processes
CO3: Analyze IP management strategies in technology organizations
CO4: Apply entrepreneurship concepts to technology ventures
CO5: Evaluate commercialization pathways for engineering innovations

Detailed Syllabus

Unit I
Intellectual property overview; need for IP protection; types of IP; patents, copyrights, trademarks, industrial designs; international IP regimes; relevance to engineering innovation and research-driven product development ecosystems.

Unit II
Patent system; patentability criteria; prior art search; patent drafting basics; filing procedures; patent examination; infringement and enforcement; engineering case illustrations from technology-driven industries.

Unit III
Copyrights and trademarks; scope and registration; software and digital content protection; trade secrets; licensing models; IP valuation; strategic IP management in engineering enterprises.

Unit IV
Technology entrepreneurship fundamentals; innovation lifecycle; ideation to commercialization; startup ecosystems; business models; funding mechanisms; role of engineers in startups and technology ventures.

Unit V
Technology transfer and commercialization; incubators and accelerators; government policies; ethical and legal considerations; sustainability; future trends in innovation-driven economies and deep-technology entrepreneurship.

Text Books

1. Bansal, R. (2019). *Intellectual Property Rights*. Oxford University Press.
2. WIPO. (2020). *Intellectual Property Handbook*. World Intellectual Property Organization.
3. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2018). *Entrepreneurship*. McGraw-Hill.
4. Barringer, B. R., & Ireland, R. D. (2017). *Entrepreneurship: Successfully Launching New Ventures*. Pearson.
5. Trott, P. (2017). *Innovation Management and New Product Development*. Pearson.

Reference Books

1. Cornish, W., Llewelyn, D., & Aplin, T. (2019). *Intellectual Property*. Sweet & Maxwell.
2. Schilling, M. A. (2018). *Strategic Management of Technological Innovation*. McGraw-Hill.
3. Shane, S. (2017). *The Illusions of Entrepreneurship*. Yale University Press.
4. OECD. (2019). *Innovation Policy and the Economy*. OECD Publishing.
5. Indian Patent Office. (2020). *Manual of Patent Office Practice and Procedure*. Government of India.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Integrated Major Project (Industry / Research Based)

Course Category: Project Course

Credits / Contact Hours: 12 Credits / 180 Contact Hours

Course Objectives

1. Execute a comprehensive industry or research-oriented project
2. Integrate multidisciplinary engineering knowledge
3. Solve complex, real-world engineering problems

4. Demonstrate innovation, design, and analytical competence
5. Prepare for professional or research careers

Course Outcomes
CO1: Define and execute complex project objectives
CO2: Integrate advanced engineering tools and techniques
CO3: Analyze results and validate system performance
CO4: Prepare high-quality technical documentation
CO5: Defend project outcomes professionally

Guidelines
• Industry-sponsored or research-based project execution
• Periodic reviews and mentor evaluations
• Final dissertation submission and project demonstration

Evaluation Scheme
Continuous Assessment (100%)

Viva-Voce / Portfolio Evaluation

Course Category: Project Course

Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Assess overall program learning outcomes
2. Evaluate technical competence and integration ability
3. Review project work and academic portfolio
4. Assess professional communication and ethics
5. Validate readiness for industry or research careers

Course Outcomes
CO1: Demonstrate comprehensive subject knowledge
CO2: Integrate learning across the program
CO3: Defend project and portfolio effectively
CO4: Exhibit professional communication skills
CO5: Demonstrate ethical and professional readiness

Guidelines
• Viva-voce examination by internal and external experts
• Evaluation of academic portfolio and project outcomes
• Assessment of technical depth and professional competence

Evaluation Scheme
Continuous Assessment (100%)

B.Sc. – Semiconductor Devices & Nano-Electronics

Duration: 3 Years | 6 Semesters | Total Credits: 120

SEMESTER I – B.Sc. Semiconductor Devices & Nano-Electronics

Mathematics I (Calculus & Linear Algebra)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical foundations required for engineering problem solving
2. Apply differential calculus to physical and engineering systems
3. Analyze functions using integral calculus techniques
4. Understand vector spaces and linear transformations
5. Solve systems of equations relevant to engineering models

Course Outcomes
CO1 Apply limits, continuity, and differentiation techniques
CO2 Solve engineering problems using differential calculus
CO3 Apply integral calculus to physical applications
CO4 Use matrices and determinants in system analysis
CO5 Apply eigenvalues and eigenvectors in engineering contexts

Detailed Syllabus

Unit I
Functions, limits, continuity; standard limit evaluation techniques, algebraic manipulation, graphical interpretation; continuity conditions, piecewise functions, engineering relevance; asymptotes, monotonicity; modeling of physical systems using elementary functions and limiting behavior concepts.

Unit II
Differentiation principles, derivative rules, higher order derivatives; implicit differentiation, parametric differentiation; applications to rate of change, velocity, acceleration; maxima, minima, curvature; optimization problems in engineering design, sensitivity analysis, system response characterization.

Unit III
Integral calculus concepts, standard integrals, substitution methods; definite integrals, properties; applications to area, volume, displacement; engineering applications involving

accumulated quantities; physical interpretation, average value of functions, basic numerical integration concepts.

Unit IV
Matrices, types of matrices, algebraic operations; determinants, properties, evaluation methods; inverse of matrices; solution of linear equations using matrix inversion, Cramer's rule; engineering system modeling using simultaneous linear equations and matrix formulation.

Unit V
Vector spaces, linear independence, basis, dimension; eigenvalues, eigenvectors, characteristic equations; diagonalization of matrices; applications in stability analysis, vibration problems; engineering interpretations in electrical networks, mechanical systems, transformation analysis.

Text Books

1. Kreyszig, E. (2011). *Advanced engineering mathematics* (10th ed.). Wiley.
2. Jain, R. K., & Iyengar, S. R. K. (2014). *Advanced engineering mathematics*. Narosa.
3. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' calculus* (14th ed.). Pearson.
4. Anton, H., Bivens, I., & Davis, S. (2016). *Calculus* (10th ed.). Wiley.
5. Strang, G. (2016). *Introduction to linear algebra* (5th ed.). Wellesley-Cambridge Press.

Reference Books

1. Boylestad, R. L. (2015). *Introductory circuit analysis*. Pearson.
2. Simmons, G. F. (2016). *Differential equations with applications and historical notes*. CRC Press.
3. Lipschutz, S., & Lipson, M. (2014). *Linear algebra*. McGraw-Hill.
4. Arfken, G. B., Weber, H. J., & Harris, F. E. (2013). *Mathematical methods for physicists*. Elsevier.
5. Bansal, R. K. (2018). *Engineering mathematics*. Laxmi Publications.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Physics I (Mechanics & Modern Physics)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand principles of classical mechanics
2. Analyze motion using vector and rotational mechanics
3. Apply wave mechanics to physical systems
4. Understand fundamentals of quantum physics
5. Relate modern physics concepts to electronics

Course Outcomes
CO1 Apply laws of mechanics to engineering problems
CO2 Analyze rotational and oscillatory systems
CO3 Explain wave phenomena and applications
CO4 Apply quantum concepts to physical systems
CO5 Relate modern physics to semiconductor behavior

Detailed Syllabus

Unit I
Vector mechanics, Newton's laws; work, energy, power; conservation principles; center of mass, momentum; engineering applications in motion analysis, mechanical systems, transport phenomena, force balance, dynamic equilibrium, physical modeling of moving bodies.

Unit II
Rotational mechanics, torque, angular momentum; moment of inertia, parallel axis theorem; rolling motion; gyroscopic effects; applications in machinery, turbines, flywheels; engineering relevance in mechanical stability, rotating systems, dynamic balancing analysis.

Unit III
Oscillations, simple harmonic motion; damped and forced oscillations; resonance phenomena; wave motion, superposition; standing waves; acoustics; engineering applications in vibration analysis, signal transmission, noise control, mechanical and electronic systems.

Unit IV
Quantum mechanics fundamentals; Planck's hypothesis, photoelectric effect; wave particle duality; de Broglie wavelength; uncertainty principle; Schrödinger equation concepts; physical interpretation, relevance to electronic energy states and nanostructures.

Unit V
Modern physics concepts, atomic models; X rays, Compton effect; lasers, principles, applications; introduction to solid state concepts; relevance to semiconductor physics, optoelectronic devices, modern engineering technologies and instrumentation.

Text Books

1. Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.
2. Serway, R. A., & Jewett, J. W. (2014). *Physics for scientists and engineers*. Cengage.
3. Beiser, A. (2017). *Concepts of modern physics* (7th ed.). McGraw-Hill.
4. Ghatak, A. K. (2015). *Optics*. McGraw-Hill.
5. Tipler, P. A., & Mosca, G. (2008). *Physics for scientists and engineers*. Freeman.

Reference Books

1. Eisberg, R., & Resnick, R. (2002). *Quantum physics of atoms, molecules, solids*. Wiley.
2. Kittel, C. (2005). *Introduction to solid state physics*. Wiley.
3. Young, H. D., & Freedman, R. A. (2016). *University physics*. Pearson.
4. Thornton, S. T., & Marion, J. B. (2004). *Classical dynamics*. Brooks Cole.
5. Jenkins, F. A., & White, H. E. (2012). *Fundamentals of optics*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Chemistry / Environmental Science

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand atomic structure and chemical bonding
2. Study electrochemical and corrosion principles
3. Understand polymers and nanomaterials
4. Analyze environmental pollution and control
5. Relate chemistry concepts to engineering applications

Course Outcomes
CO1 Explain atomic and molecular structure
CO2 Analyze electrochemical systems
CO3 Understand materials chemistry
CO4 Analyze environmental issues
CO5 Apply chemistry concepts in engineering

Detailed Syllabus

Unit I
Atomic structure, electronic configuration; quantum numbers; molecular orbital theory; chemical bonding, ionic, covalent, metallic bonds; intermolecular forces; engineering relevance in material behavior and chemical stability analysis.

Unit II
Electrochemistry fundamentals; electrochemical cells; electrode potentials; Nernst equation; batteries and fuel cells; corrosion mechanisms; corrosion prevention techniques; engineering relevance in energy systems and material protection strategies.

Unit III
Polymers classification; polymerization mechanisms; thermoplastics, thermosets; conducting polymers; applications; nanomaterials introduction; synthesis methods; engineering relevance in electronic materials and structural applications.

Unit IV
Water chemistry; hardness; boiler troubles; water treatment methods; environmental chemistry basics; air pollution sources; control techniques; engineering relevance in sustainable industrial practices and environmental protection.

Unit V
Green chemistry principles; renewable materials; waste minimization; life cycle assessment; environmental impact assessment; engineering relevance in sustainable design and regulatory compliance frameworks.

Text Books

1. Jain, P. C., & Jain, M. (2016). *Engineering chemistry*. Dhanpat Rai.
2. Dara, S. S., & Dara, S. (2018). *Engineering chemistry*. S. Chand.
3. Bahl, A., & Bahl, B. S. (2019). *A textbook of organic chemistry*. S. Chand.
4. Sharma, B. K. (2015). *Environmental chemistry*. Goel.
5. Manahan, S. E. (2017). *Environmental chemistry*. CRC Press.

Reference Books

1. Atkins, P., & de Paula, J. (2014). *Physical chemistry*. Oxford.
2. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2003). *Chemistry for environmental engineering*. McGraw-Hill.
3. Callister, W. D. (2018). *Materials science and engineering*. Wiley.
4. Moore, J. W., & Moore, E. A. (2013). *Environmental chemistry*. Academic Press.
5. Anastas, P. T., & Warner, J. C. (2000). *Green chemistry*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Basics of Electrical & Electronics Engineering

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand basic electrical quantities and laws
2. Analyze DC and AC circuits
3. Understand electrical machines basics
4. Study basic electronic components
5. Apply fundamentals in engineering systems

Course Outcomes
CO1 Apply electrical laws
CO2 Analyze simple circuits
CO3 Explain machine principles
CO4 Understand electronic components
CO5 Apply fundamentals in practice

Detailed Syllabus

Unit I
Electrical quantities, voltage, current, resistance; Ohm's law; Kirchhoff laws; DC circuits; series parallel networks; power and energy; engineering relevance in basic electrical system analysis.

Unit II
AC fundamentals; sinusoidal waveforms; RMS values; impedance; resonance; power factor; engineering relevance in AC power systems and electrical equipment operation.

Unit III
Electrical machines overview; transformers; DC machines; induction motors; construction and principles; engineering relevance in energy conversion and industrial applications.

Unit IV
Electronic components; diodes; transistors; rectifiers; amplifiers basics; engineering relevance in signal conditioning and power electronics fundamentals.

Unit V
Measurement instruments; voltmeter, ammeter; wattmeter; energy meter; safety practices; engineering relevance in electrical testing and laboratory operations.

Text Books

1. Theraja, B. L., & Theraja, A. K. (2019). *A textbook of electrical technology*. S. Chand.
2. Hughes, E. (2017). *Electrical and electronic technology*. Pearson.
3. Boylestad, R. L. (2015). *Introductory circuit analysis*. Pearson.
4. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2013). *Electric machinery*. McGraw-Hill.
5. Rao, S. S. (2018). *Basic electrical engineering*. McGraw-Hill.

Reference Books

1. Nilsson, J. W., & Riedel, S. (2014). *Electric circuits*. Pearson.
2. Ghosh, S. (2018). *Electrical machines*. McGraw-Hill.
3. Alexander, C. K., & Sadiku, M. (2017). *Fundamentals of electric circuits*. McGraw-Hill.
4. Chapman, S. J. (2012). *Electric machinery fundamentals*. McGraw-Hill.
5. Nagrath, I. J., & Kothari, D. P. (2016). *Basic electrical engineering*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Programming Fundamentals (C / Python)

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand programming concepts
2. Develop algorithmic thinking
3. Write structured programs
4. Understand data handling
5. Apply programming in engineering

Course Outcomes
CO1 Write basic programs
CO2 Use control structures
CO3 Apply functions and arrays
CO4 Handle files and data
CO5 Solve engineering problems

Detailed Syllabus

Unit I
Problem solving concepts; algorithms; flowcharts; programming structure; C or Python syntax basics; data types; variables; engineering relevance in computational thinking and automation.

Unit II
Operators; expressions; input output statements; decision making; conditional constructs; engineering relevance in logical control and program flow management.

Unit III
Looping constructs; for while loops; nested loops; pattern generation; engineering relevance in repetitive computation and numerical processing.

Unit IV
Functions; modular programming; arrays; strings; pointers or lists; engineering relevance in structured program development and memory management.

Unit V
File handling basics; error handling; simple applications; engineering relevance in data processing, simulation tasks, and basic software tool development.

Text Books

1. Kernighan, B. W., & Ritchie, D. M. (2015). *The C programming language*. PHI.
2. Reema Thareja. (2016). *Programming in C*. Oxford.
3. Lutz, M. (2013). *Learning Python*. O'Reilly.
4. Downey, A. B. (2015). *Think Python*. O'Reilly.
5. Kanetkar, Y. (2017). *Let us C*. BPB.

Reference Books

1. Deitel, P., & Deitel, H. (2016). *C how to program*. Pearson.
2. Zelle, J. (2016). *Python programming*. Franklin.
3. Guttag, J. (2016). *Introduction to computation and programming*. MIT Press.
4. Horowitz, E., & Sahni, S. (2014). *Fundamentals of computer algorithms*. Galgotia.
5. McConnell, S. (2004). *Code complete*. Microsoft Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Improve listening and speaking skills
2. Develop reading comprehension
3. Enhance writing skills
4. Build professional communication
5. Prepare for workplace communication

Course Outcomes
CO1 Communicate effectively
CO2 Demonstrate language proficiency
CO3 Prepare technical documents
CO4 Perform presentations
CO5 Apply professional etiquette

Guidelines
Listening exercises; spoken English practice; reading technical texts; report writing; presentations; group discussions

Evaluation Scheme
Continuous Assessment (100%)

Laboratory Practice I (Physics / Electronics)

Course Category: Engineering Science Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Understand basic laboratory practices
2. Perform physics and electronics experiments
3. Use measuring instruments
4. Record and analyze data
5. Follow safety procedures

Course Outcomes
CO1 Perform basic experiments
CO2 Use laboratory instruments
CO3 Record observations accurately

CO4 Analyze experimental data
CO5 Prepare laboratory records

List of Experiments / Exercises

1. Verification of Ohm's law using DC power supply, voltmeter, ammeter, resistance variation, result interpretation.
2. Series and parallel resistance network analysis using breadboard setup, multimeter measurements, power calculation.
3. Study of PN junction diode characteristics using regulated supply, current voltage plotting, parameter identification.
4. Half wave and full wave rectifier analysis using diodes, CRO observation, ripple factor estimation.
5. Measurement of resistance using Wheatstone bridge, balancing technique, error estimation.
6. Study of basic electronic components resistors, capacitors, inductors using LCR meter, tolerance identification.
7. Transistor identification and testing using multimeter, terminal recognition, basic functionality check.
8. Study of CRO operation, waveform observation, amplitude and frequency measurement.
9. Verification of Kirchhoff laws using DC circuits, experimental validation, error analysis.
10. Viva voce and record evaluation based on conducted experiments and observations.

Expected Outcomes
Hands on experimental skills; familiarity with instruments; data analysis ability; laboratory discipline; technical documentation skills.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER II – B.Sc. Semiconductor Devices & Nano-Electronics

Mathematics II (Probability & Statistics)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop probabilistic thinking for engineering analysis
2. Apply random variables to model engineering uncertainty
3. Understand statistical distributions and properties
4. Perform statistical data analysis and inference
5. Apply probability and statistics in engineering applications

Course Outcomes
CO1 Apply probability laws to engineering problems
CO2 Analyze discrete and continuous random variables
CO3 Use standard probability distributions
CO4 Perform estimation and hypothesis testing
CO5 Apply statistical methods in engineering data analysis

Detailed Syllabus

Unit I
Probability concepts, sample space, events; axioms of probability, addition and multiplication theorems; conditional probability, Bayes theorem; applications in engineering decision making, reliability estimation, uncertainty modeling, probabilistic reasoning, system performance analysis.

Unit II
Random variables, discrete and continuous types; probability mass and density functions; cumulative distribution functions; expectation, variance, moments; engineering applications involving noise modeling, tolerance analysis, performance variation, stochastic representation of physical quantities.

Unit III
Discrete probability distributions; binomial, Poisson, geometric distributions; mean, variance, characteristics; continuous distributions, uniform, exponential, normal distributions; engineering applications in communication systems, reliability modeling, failure analysis, quality assessment.

Unit IV
Joint distributions, marginal and conditional distributions; covariance, correlation coefficient; transformation of variables; regression analysis; engineering interpretation in multivariable

systems, dependency analysis, signal correlation, system parameter estimation, experimental data modeling.

Unit V
Sampling theory, sampling distributions; estimation, confidence intervals; hypothesis testing, parametric tests; goodness of fit; analysis of variance concepts; engineering applications in process control, experimental validation, statistical quality control, decision support systems.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and statistics for engineers and scientists*. Pearson.
2. Devore, J. L. (2015). *Probability and statistics for engineering and the sciences*. Cengage.
3. Hines, W. W., Montgomery, D. C., Goldsman, D. M., & Borror, C. M. (2014). *Probability and statistics in engineering*. Wiley.
4. Ross, S. M. (2019). *Introduction to probability and statistics for engineers and scientists*. Academic Press.
5. Johnson, R. A. (2018). *Miller and Freund's probability and statistics for engineers*. Pearson.

Reference Books

1. Papoulis, A., & Pillai, S. U. (2002). *Probability, random variables, and stochastic processes*. McGraw-Hill.
2. Montgomery, D. C., & Runger, G. C. (2018). *Applied statistics and probability for engineers*. Wiley.
3. Spiegel, M. R., Schiller, J., & Srinivasan, R. (2013). *Probability and statistics*. McGraw-Hill.
4. Mood, A. M., Graybill, F. A., & Boes, D. C. (2010). *Introduction to the theory of statistics*. McGraw-Hill.
5. Gupta, S. C., & Kapoor, V. K. (2016). *Fundamentals of mathematical statistics*. Sultan Chand.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Engineering Physics II (Solid State Physics)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand crystal structure and bonding in solids
2. Analyze electrical properties of materials
3. Understand semiconductors and carrier behavior
4. Apply band theory to electronic materials
5. Relate solid state physics to device applications

Course Outcomes
CO1 Explain crystal structures and imperfections
CO2 Analyze electrical properties of solids
CO3 Apply band theory to semiconductors
CO4 Explain carrier transport phenomena
CO5 Relate solid state concepts to electronic devices

Detailed Syllabus

Unit I
Crystal structures, lattice parameters; unit cells, Bravais lattices; Miller indices; crystal planes; packing density; bonding in solids; engineering relevance in material selection, structural analysis, semiconductor lattice characterization.

Unit II
Imperfections in solids, point defects, line defects; dislocations; grain boundaries; diffusion mechanisms; engineering significance in mechanical strength, electrical behavior, material reliability, fabrication processes, semiconductor defect engineering.

Unit III
Free electron theory, electrical conductivity; classical and quantum models; energy bands; metals, insulators, semiconductors; effective mass; density of states; engineering interpretation in electronic material behavior and conductivity control.

Unit IV
Semiconductor physics basics; intrinsic and extrinsic semiconductors; carrier concentration; Fermi level; temperature dependence; carrier mobility; drift and diffusion; engineering applications in electronic and optoelectronic devices.

Unit V
Dielectric properties, polarization mechanisms; magnetic properties of materials; dia, para, ferromagnetism; superconductivity basics; engineering applications in electronic components, memory devices, sensors, advanced material technologies.

Text Books

1. Kittel, C. (2005). *Introduction to solid state physics*. Wiley.
2. Callister, W. D., & Rethwisch, D. G. (2018). *Materials science and engineering*. Wiley.
3. Singh, J. (2014). *Semiconductor devices*. McGraw-Hill.
4. Dekker, A. J. (2011). *Solid state physics*. Pearson.
5. Neamen, D. A. (2012). *Semiconductor physics and devices*. McGraw-Hill.

Reference Books

1. Ashcroft, N. W., & Mermin, N. D. (2011). *Solid state physics*. Cengage.
2. Solymar, L., & Walsh, D. (2014). *Lectures on the electrical properties of materials*. Oxford.
3. Elliott, R. J., & Dawber, M. (2018). *Symmetry in physics*. Oxford.
4. Gupta, S. C. (2017). *Solid state physics*. Vikas.
5. Omar, M. A. (2012). *Elementary solid state physics*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Electronic Circuits & Network Theory

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand electrical network fundamentals
2. Analyze DC and AC circuits
3. Apply network theorems for circuit simplification
4. Analyze transient and steady state responses
5. Develop problem solving skills in circuit analysis

Course Outcomes
CO1 Apply circuit laws to electrical networks
CO2 Analyze AC and DC circuits
CO3 Use network theorems effectively
CO4 Analyze transient behavior of circuits
CO5 Solve practical engineering circuit problems

Detailed Syllabus

Unit I
Electrical circuit elements, sources; Kirchhoff laws; network topology; mesh and nodal analysis; source transformation; engineering applications in electrical network modeling, systematic circuit solution techniques, analysis of practical electrical systems.

Unit II
Network theorems, superposition, Thevenin, Norton, maximum power transfer; linearity concepts; applications to complex networks; engineering relevance in circuit simplification, load analysis, power optimization, system performance evaluation.

Unit III
AC fundamentals, sinusoidal waveforms; phasor representation; impedance, admittance; AC circuit analysis; resonance; power factor; engineering applications in electrical machines, communication circuits, signal processing systems.

Unit IV
Transient analysis, first order circuits; RL, RC circuits; time constants; step response; initial and final conditions; engineering relevance in switching circuits, timing applications, pulse response analysis.

Unit V
Two port networks, parameters; Z, Y, h, ABCD parameters; interconnections; frequency response basics; engineering applications in amplifier modeling, communication networks, system interconnection analysis.

Text Books

1. Alexander, C. K., & Sadiku, M. N. O. (2017). *Fundamentals of electric circuits*. McGraw-Hill.
2. Hayt, W. H., Kemmerly, J. E., & Durbin, S. M. (2012). *Engineering circuit analysis*. McGraw-Hill.
3. Van Valkenburg, M. E. (2015). *Network analysis*. Pearson.
4. Boylestad, R. L. (2015). *Introductory circuit analysis*. Pearson.
5. Theraja, B. L., & Theraja, A. K. (2019). *A textbook of electrical technology*. S. Chand.

Reference Books

1. Edminister, J. A., & Nahvi, M. (2010). *Schaum's outline of electric circuits*. McGraw-Hill.
2. Nilsson, J. W., & Riedel, S. A. (2014). *Electric circuits*. Pearson.
3. Ghosh, S. (2018). *Network analysis*. McGraw-Hill.
4. Dutta Roy, S. C. (2017). *Networks and systems*. New Age.

5. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2013). *Electric machinery*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Electronics Fundamentals

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand number systems and logic gates
2. Analyze combinational logic circuits
3. Design sequential logic circuits
4. Understand memory and logic families
5. Apply digital logic in engineering systems

Course Outcomes
CO1 Convert and analyze number systems
CO2 Design combinational logic circuits
CO3 Analyze sequential logic circuits
CO4 Understand memory devices and logic families
CO5 Apply digital concepts in system design

Detailed Syllabus

Unit I
Number systems, binary, octal, hexadecimal; number conversions; binary arithmetic; logic gates; Boolean algebra; De Morgan's theorems; engineering applications in digital computation and logic design.

Unit II
Combinational logic circuits; Boolean function simplification; Karnaugh maps; arithmetic circuits; multiplexers, demultiplexers; encoders, decoders; engineering applications in digital system building blocks.

Unit III
Sequential logic circuits; latches, flip flops; registers, counters; timing diagrams; state tables; engineering applications in control systems, timing circuits, digital controllers.

Unit IV
Memory devices; ROM, RAM types; programmable logic devices; PLA, PAL; engineering relevance in data storage, system configuration, digital hardware design.

Unit V
Logic families; TTL, CMOS characteristics; power dissipation; speed; noise margin; interfacing considerations; engineering applications in digital circuit implementation and hardware selection.

Text Books

1. Mano, M. M., & Ciletti, M. D. (2017). *Digital design*. Pearson.
2. Floyd, T. L. (2015). *Digital fundamentals*. Pearson.
3. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2016). *Digital systems*. Pearson.
4. Roth, C. H., & Kinney, L. L. (2014). *Fundamentals of logic design*. Cengage.
5. Jain, R. P. (2018). *Modern digital electronics*. McGraw-Hill.

Reference Books

1. Wakerly, J. F. (2006). *Digital design*. Pearson.
2. Malvino, A. P., & Brown, J. A. (2016). *Digital computer electronics*. McGraw-Hill.
3. Gothmann, W. H. (2013). *Digital electronics*. Prentice Hall.
4. Salivahanan, S., & Arivazhagan, S. (2018). *Digital circuits and design*. Oxford.
5. Leach, D. P., & Malvino, A. P. (2015). *Digital principles and applications*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Materials Science for Electronics

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand material structure and properties
2. Relate material properties to electronic behavior
3. Understand semiconducting materials
4. Analyze magnetic and dielectric materials
5. Apply materials science in electronics

Course Outcomes
CO1 Explain structure property relationships
CO2 Analyze electrical properties of materials

CO3 Understand semiconductor materials
CO4 Explain magnetic and dielectric behavior
CO5 Apply material selection in electronics

Detailed Syllabus

Unit I
Atomic structure, bonding; crystal structures; material classification; structure property relationships; engineering relevance in electronic material selection, performance analysis, reliability considerations.

Unit II
Electrical properties of materials; conductivity, resistivity; semiconductors, insulators; temperature effects; engineering applications in electronic components and device behavior.

Unit III
Semiconductor materials; silicon, germanium, compound semiconductors; doping; carrier concentration; engineering relevance in device fabrication and performance optimization.

Unit IV
Magnetic materials; dia, para, ferromagnetism; hysteresis; applications in electronics; engineering relevance in memory devices, sensors, transformers.

Unit V
Dielectric materials; polarization; dielectric loss; ferroelectric materials; applications in capacitors, insulating materials, electronic packaging technologies.

Text Books

1. Callister, W. D., & Rethwisch, D. G. (2018). *Materials science and engineering*. Wiley.
2. Kasap, S. O. (2018). *Principles of electronic materials and devices*. McGraw-Hill.
3. Shackelford, J. F. (2015). *Introduction to materials science for engineers*. Pearson.
4. Raghavan, V. (2015). *Materials science and engineering*. Prentice Hall.
5. Singh, V. (2017). *Materials science*. McGraw-Hill.

Reference Books

1. Smith, W. F. (2011). *Foundations of materials science and engineering*. McGraw-Hill.
2. Kittel, C. (2005). *Introduction to solid state physics*. Wiley.
3. Chiang, Y. M., Birnie, D. P., & Kingery, W. D. (2011). *Physical ceramics*. Wiley.
4. Ashby, M. F. (2011). *Materials selection in mechanical design*. Butterworth.
5. Van Vlack, L. H. (2013). *Elements of materials science and engineering*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop creative problem solving skills
2. Apply design thinking methodology
3. Foster innovation mindset
4. Encourage teamwork and communication
5. Apply design thinking to engineering problems

Course Outcomes
CO1 Apply design thinking principles
CO2 Identify and define engineering problems
CO3 Generate innovative solutions
CO4 Develop prototypes and concepts
CO5 Demonstrate teamwork and communication

Detailed Syllabus

Unit I
Design thinking fundamentals; human centered design; empathy mapping; problem identification; engineering relevance in user focused solution development.

Unit II
Ideation techniques; brainstorming; creative thinking tools; innovation processes; engineering application in solution generation.

Unit III
Concept development; prototyping; feasibility analysis; engineering relevance in product development and validation.

Unit IV
Design evaluation; testing; iteration; feedback integration; engineering relevance in continuous improvement.

Unit V
Innovation management; entrepreneurship basics; intellectual property awareness; engineering relevance in technology commercialization.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.
2. Liedtka, J., & Ogilvie, T. (2011). *Designing for growth*. Columbia.
3. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown.
4. Martin, R. L. (2009). *The design of business*. Harvard.
5. Dam, R. F., & Siang, T. Y. (2020). *Design thinking handbook*. Interaction Design.

Reference Books

1. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.
2. Blank, S. (2013). *The startup owner's manual*. K&S Ranch.
3. Ries, E. (2011). *The lean startup*. Crown.
4. IDEO. (2015). *The field guide to human centered design*. IDEO.
5. Ulrich, K. T., & Eppinger, S. D. (2016). *Product design and development*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (100%)

Internship / Industrial Orientation

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industrial environment
2. Understand workplace practices
3. Relate theory to practice
4. Develop professional skills
5. Encourage industry interaction

Course Outcomes
CO1 Understand industrial operations
CO2 Observe professional practices
CO3 Relate academic learning to industry
CO4 Develop communication and teamwork skills
CO5 Prepare basic industrial reports

Guidelines
Industry orientation program; industrial visits; expert lectures; report preparation; assessment through participation and report submission

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER III – B.Sc. Semiconductor Devices & Nano-Electronics

Course 1: Semiconductor Physics

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand crystal structure and energy band concepts
2. Analyze charge carriers and transport phenomena
3. Study equilibrium and non equilibrium semiconductor behavior
4. Understand pn junction characteristics
5. Relate semiconductor physics to device operation

Course Outcomes
CO1 Explain energy bands and carrier statistics
CO2 Analyze carrier transport mechanisms
CO3 Evaluate equilibrium conditions in semiconductors
CO4 Analyze pn junction behavior
CO5 Relate physics concepts to semiconductor devices

Detailed Syllabus

Unit I
Crystal lattices, bonding mechanisms; energy band formation, allowed and forbidden bands; direct and indirect band gap materials; density of states; effective mass concepts; relevance to electronic and optoelectronic material selection.

Unit II
Carrier statistics, Fermi Dirac distribution; intrinsic semiconductors, carrier concentration; extrinsic semiconductors, doping effects; Fermi level variation; temperature dependence; engineering relevance in conductivity control and material optimization.

Unit III
Carrier transport mechanisms; drift under electric field, mobility; diffusion due to concentration gradient; Einstein relation; continuity equation concepts; recombination and generation processes; relevance in device current flow and transient response.

Unit IV
Equilibrium semiconductor conditions; built in potential; pn junction formation; depletion region; space charge distribution; electric field and potential profiles; engineering relevance in diode operation and junction based devices.

Unit V
Non equilibrium conditions; biasing of pn junctions; current components; ideal diode equation; breakdown mechanisms; junction capacitances; relevance to rectifiers, switching devices, signal processing applications.

Text Books

1. Neamen, D. A. (2012). *Semiconductor physics and devices* (4th ed.). McGraw-Hill.
2. Pierret, R. F. (2003). *Semiconductor device fundamentals*. Pearson.
3. Singh, J. (2014). *Semiconductor devices*. McGraw-Hill.
4. Streetman, B. G., & Banerjee, S. (2016). *Solid state electronic devices*. Pearson.
5. Sze, S. M., & Ng, K. K. (2007). *Physics of semiconductor devices*. Wiley.

Reference Books

1. Kittel, C. (2005). *Introduction to solid state physics*. Wiley.
2. Kasap, S. O. (2018). *Principles of electronic materials and devices*. McGraw-Hill.
3. Singh, R. (2010). *Semiconductor devices*. McGraw-Hill.
4. Madou, M. J. (2011). *Fundamentals of microfabrication*. CRC Press.
5. Wolf, S., & Tauber, R. N. (2000). *Silicon processing for the VLSI era*. Lattice Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Electronic Devices & Applications

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand operation of basic electronic devices
2. Analyze characteristics of diodes and transistors
3. Study special purpose semiconductor devices
4. Apply devices in electronic circuits
5. Develop device level application understanding

Course Outcomes
CO1 Analyze diode characteristics and applications
CO2 Explain BJT operation and configurations
CO3 Explain FET operation and characteristics

CO4 Understand special purpose devices
CO5 Apply devices in practical circuits

Detailed Syllabus

Unit I
Diodes, ideal and practical characteristics; rectifiers, half wave and full wave; filters; voltage regulation concepts; Zener diode behavior; engineering applications in power supplies and signal conditioning circuits.

Unit II
Bipolar junction transistor structure; operation principles; current components; configurations, CE, CB, CC; characteristics; biasing techniques; engineering relevance in amplification and switching applications.

Unit III
Field effect transistors; JFET operation, characteristics; MOSFET structure, enhancement and depletion modes; characteristics; biasing methods; relevance in low power circuits and integrated electronics.

Unit IV
Special purpose devices; LED, photodiodes, solar cells; optocouplers; tunnel diode; SCR basics; engineering relevance in optoelectronics, power control, sensing applications.

Unit V
Device applications; amplifiers, switching circuits; waveform shaping; power electronic basics; device selection criteria; reliability considerations; relevance in electronic system design and implementation.

Text Books

1. Streetman, B. G., & Banerjee, S. (2016). *Solid state electronic devices*. Pearson.
2. Boylestad, R. L., & Nashelsky, L. (2015). *Electronic devices and circuit theory*. Pearson.
3. Neamen, D. A. (2012). *Semiconductor physics and devices*. McGraw-Hill.
4. Millman, J., & Halkias, C. C. (2010). *Integrated electronics*. McGraw-Hill.
5. Singh, J. (2014). *Semiconductor devices*. McGraw-Hill.

Reference Books

1. Sze, S. M., & Ng, K. K. (2007). *Physics of semiconductor devices*. Wiley.
2. Sedra, A. S., & Smith, K. C. (2014). *Microelectronic circuits*. Oxford.
3. Floyd, T. L. (2015). *Electronic devices*. Pearson.
4. Malvino, A. P., & Bates, D. J. (2016). *Electronic principles*. McGraw-Hill.

5. Roulston, D. J. (1999). *Bipolar semiconductor devices*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Analog Electronics

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand amplifier fundamentals
2. Analyze multistage amplifiers
3. Study feedback and oscillators
4. Understand power amplifiers
5. Apply analog circuits in systems

Course Outcomes
CO1 Analyze small signal amplifiers
CO2 Design multistage amplifier circuits
CO3 Apply feedback principles
CO4 Analyze oscillator circuits
CO5 Apply analog electronics concepts

Detailed Syllabus

Unit I
Small signal amplifiers; CE, CB, CC configurations; hybrid models; gain analysis; frequency response; engineering relevance in signal amplification and conditioning circuits.

Unit II
Multistage amplifiers; RC coupled, transformer coupled; frequency response; bandwidth considerations; engineering relevance in audio and communication systems.

Unit III
Feedback amplifiers; feedback concepts; types of feedback; stability; gain bandwidth tradeoff; engineering relevance in noise reduction and performance enhancement.

Unit IV
Oscillators; Barkhausen criterion; RC oscillators; LC oscillators; crystal oscillators; frequency stability; engineering relevance in signal generation systems.

Unit V
Power amplifiers; classification; efficiency; distortion; heat dissipation; engineering relevance in audio systems and power electronic interfaces.

Text Books

1. Boylestad, R. L., & Nashelsky, L. (2015). *Electronic devices and circuit theory*. Pearson.
2. Sedra, A. S., & Smith, K. C. (2014). *Microelectronic circuits*. Oxford.
3. Millman, J., & Halkias, C. C. (2010). *Integrated electronics*. McGraw-Hill.
4. Malvino, A. P., & Bates, D. J. (2016). *Electronic principles*. McGraw-Hill.
5. Floyd, T. L. (2015). *Electronic devices*. Pearson.

Reference Books

1. Gray, P. R., Hurst, P. J., Lewis, S. H., & Meyer, R. G. (2009). *Analysis and design of analog integrated circuits*. Wiley.
2. Razavi, B. (2016). *Fundamentals of microelectronics*. Wiley.
3. Tietze, U., & Schenk, C. (2015). *Electronic circuits*. Springer.
4. Laker, K. R., & Sansen, W. M. C. (1994). *Design of analog integrated circuits*. McGraw-Hill.
5. Franco, S. (2015). *Design with operational amplifiers*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Signals & Systems

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand signal representation
2. Analyze linear time invariant systems
3. Apply transform techniques
4. Analyze continuous time systems
5. Relate signals and systems to applications

Course Outcomes
CO1 Classify and represent signals
CO2 Analyze LTI systems
CO3 Apply Fourier analysis

CO4 Apply Laplace transform techniques
CO5 Analyze system behavior

Detailed Syllabus

Unit I
Signal classification; continuous and discrete signals; periodic and aperiodic; energy and power signals; basic operations; engineering relevance in system representation and analysis.

Unit II
System classification; linearity, time invariance; impulse response; convolution integral; stability and causality; engineering relevance in system modeling and response analysis.

Unit III
Fourier series; trigonometric and exponential forms; Fourier transform; properties; frequency spectrum; engineering relevance in signal analysis and communication systems.

Unit IV
Laplace transform; properties; inverse transform; system transfer function; poles and zeros; engineering relevance in control systems and circuit analysis.

Unit V
Time domain and frequency domain analysis; system response; filtering concepts; engineering relevance in signal processing and electronic systems.

Text Books

1. Oppenheim, A. V., Willsky, A. S., & Nawab, S. H. (2014). *Signals and systems*. Pearson.
2. Lathi, B. P. (2017). *Linear systems and signals*. Oxford.
3. Haykin, S., & Van Veen, B. (2003). *Signals and systems*. Wiley.
4. Rao, S. S. (2018). *Signals and systems*. McGraw-Hill.
5. Proakis, J. G., & Manolakis, D. G. (2006). *Digital signal processing*. Pearson.

Reference Books

1. Simon, H. (2013). *Signals and systems*. McGraw-Hill.
2. Hsu, H. P. (2014). *Signals and systems*. Schaum's.
3. Ziemer, R. E., Tranter, W. H., & Fannin, D. R. (2014). *Signals and systems*. Pearson.
4. Oppenheim, A. V., & Schafer, R. W. (2010). *Discrete time signal processing*. Pearson.
5. Mitra, S. K. (2011). *Digital signal processing*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Measurement & Instrumentation

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand measurement principles
2. Study sensors and transducers
3. Analyze instrumentation systems
4. Understand error and calibration
5. Apply measurement techniques

Course Outcomes
CO1 Explain measurement concepts
CO2 Analyze sensors and transducers
CO3 Apply instrumentation techniques
CO4 Evaluate measurement errors
CO5 Apply measurement systems

Detailed Syllabus

Unit I
Measurement fundamentals; accuracy, precision; standards; static and dynamic characteristics; engineering relevance in experimental analysis and system evaluation.

Unit II
Errors in measurement; types; propagation; calibration techniques; engineering relevance in quality assurance and reliability assessment.

Unit III
Sensors and transducers; resistive, inductive, capacitive; thermal sensors; engineering relevance in data acquisition and control systems.

Unit IV
Instrumentation systems; signal conditioning; amplifiers; filters; data acquisition systems; engineering relevance in automated measurements.

Unit V
Measurement applications; electrical and electronic measurements; oscilloscopes; bridges; engineering relevance in testing and validation of electronic systems.

Text Books

1. Doebelin, E. O., & Manik, D. N. (2011). *Measurement systems*. McGraw-Hill.
2. Sawhney, A. K. (2015). *Electrical and electronic measurements*. Dhanpat Rai.

3. Morris, A. S., & Langari, R. (2012). *Measurement and instrumentation*. Academic Press.
4. Helfrick, A. D., & Cooper, W. D. (2013). *Modern electronic instrumentation*. Pearson.
5. Bentley, J. P. (2005). *Principles of measurement systems*. Pearson.

Reference Books

1. Goldstein, H. (2014). *Electronic measurements and instrumentation*. McGraw-Hill.
2. Webster, J. G. (2009). *Measurement, instrumentation, and sensors handbook*. CRC Press.
3. Patranabis, D. (2014). *Sensors and transducers*. PHI.
4. Raghuwanshi, B. S. (2017). *Electronic instrumentation*. McGraw-Hill.
5. Figliola, R. S., & Beasley, D. E. (2015). *Theory and design for mechanical measurements*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Ethics / Indian Constitution)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand ethical principles
2. Develop professional responsibility
3. Understand constitutional values
4. Promote social awareness
5. Apply ethics in engineering practice

Course Outcomes
CO1 Explain ethical theories
CO2 Apply ethics in professional scenarios
CO3 Understand constitutional principles
CO4 Analyze social responsibilities
CO5 Demonstrate responsible citizenship

Guidelines
Professional ethics concepts; engineering responsibility; constitutional framework; fundamental rights and duties; social justice; assessment through assignments and discussions

Evaluation Scheme
Continuous Assessment (100%)

Course 7: Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide industry exposure
2. Apply academic knowledge
3. Develop professional skills
4. Understand workplace practices
5. Enhance employability

Course Outcomes
CO1 Observe industrial operations
CO2 Apply theoretical knowledge
CO3 Develop professional conduct
CO4 Improve communication skills
CO5 Prepare internship documentation

Guidelines
Industry based training; supervised learning; report preparation; evaluation based on performance and report submission

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IV – B.Sc. Semiconductor Devices & Nano-Electronics

Course 1: Integrated Circuits & Fabrication Technology

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand IC classification and fabrication fundamentals
2. Study semiconductor fabrication processes
3. Analyze MOS and bipolar IC technologies
4. Understand cleanroom and process integration concepts
5. Relate fabrication steps to device performance

Course Outcomes
CO1 Explain IC types and fabrication flow
CO2 Analyze oxidation and diffusion processes
CO3 Understand lithography and etching techniques
CO4 Explain MOS and bipolar IC fabrication
CO5 Relate process parameters to device characteristics

Detailed Syllabus

Unit I
Integrated circuits overview; SSI, MSI, LSI, VLSI classification; IC fabrication philosophy; cleanroom concepts; contamination control; wafer preparation; crystal growth; engineering relevance in semiconductor manufacturing and yield optimization.

Unit II
Thermal oxidation; dry and wet oxidation; diffusion mechanisms; Fick's laws; ion implantation concepts; annealing; process parameters; engineering relevance in junction formation, dopant control, and electrical property tuning.

Unit III
Photolithography principles; masks, photoresists; exposure systems; alignment; resolution; etching techniques, wet and dry etching; process integration; engineering relevance in pattern transfer and dimensional control.

Unit IV
Thin film deposition; CVD, PVD; epitaxy; metallization; interconnect materials; contact formation; engineering relevance in multilayer interconnects, device reliability, and performance enhancement.

Unit V
MOS IC fabrication; NMOS, PMOS, CMOS processes; bipolar IC fabrication overview; isolation techniques; scaling concepts; engineering relevance in modern IC manufacturing and technology node evolution.

Text Books

1. Jaeger, R. C. (2002). *Introduction to microelectronic fabrication*. Pearson.
2. Madou, M. J. (2011). *Fundamentals of microfabrication and nanotechnology*. CRC Press.
3. Wolf, S., & Tauber, R. N. (2000). *Silicon processing for the VLSI era*. Lattice Press.
4. Campbell, S. A. (2008). *The science and engineering of microelectronic fabrication*. Oxford.
5. Plummer, J. D., Deal, M., & Griffin, P. (2000). *Silicon VLSI technology*. Prentice Hall.

Reference Books

1. Sze, S. M., & Ng, K. K. (2007). *Physics of semiconductor devices*. Wiley.
2. Streetman, B. G., & Banerjee, S. (2016). *Solid state electronic devices*. Pearson.
3. Jaeger, R. C., & Blalock, T. N. (2010). *Microelectronic circuit design*. McGraw-Hill.
4. Van Zant, P. (2014). *Microchip fabrication*. McGraw-Hill.
5. Chang, S. T. (2016). *Semiconductor manufacturing handbook*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Microprocessors & Microcontrollers

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand microprocessor architecture
2. Learn instruction sets and programming concepts
3. Understand microcontroller architecture
4. Interface peripherals and memory
5. Apply processors in embedded systems

Course Outcomes
CO1 Explain microprocessor architecture

CO2 Write assembly level programs
CO3 Explain microcontroller features
CO4 Interface peripherals
CO5 Apply processors in embedded applications

Detailed Syllabus

Unit I
Microprocessor fundamentals; architecture overview; registers; buses; instruction cycle; timing; engineering relevance in programmable system design and computational control.

Unit II
Instruction sets; addressing modes; assembly language programming; stack operations; subroutines; engineering relevance in low level software development and hardware control.

Unit III
Microcontroller architecture; features; memory organization; I O ports; timers; interrupts; engineering relevance in embedded control systems and automation.

Unit IV
Interfacing concepts; memory interfacing; peripheral interfacing; serial communication basics; engineering relevance in system integration and hardware expansion.

Unit V
Embedded system applications; real time constraints; system design considerations; engineering relevance in consumer electronics, industrial control, and IoT devices.

Text Books

1. Gaonkar, R. S. (2013). *Microprocessor architecture, programming, and applications*. Wiley.
2. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. (2014). *The 8051 microcontroller*. Pearson.
3. Brey, B. B. (2012). *The Intel microprocessors*. Pearson.
4. Ayala, K. J. (2011). *The 8051 microcontroller*. Cengage.
5. Barret, S. F., & Pack, D. J. (2012). *Microcontrollers fundamentals*. Morgan Claypool.

Reference Books

1. Krishna Kant. (2015). *Microprocessors and microcontrollers*. PHI.
2. Raj Kamal. (2017). *Embedded systems*. McGraw-Hill.
3. Peatman, J. B. (2012). *Design with microcontrollers*. Pearson.
4. Heath, S. (2003). *Embedded systems design*. Newnes.
5. Valvano, J. (2012). *Embedded systems*. Cengage.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Nano-Materials & Nano-Structures

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand nanoscale concepts
2. Study synthesis of nanomaterials
3. Analyze properties of nanostructures
4. Understand characterization techniques
5. Apply nanomaterials in electronics

Course Outcomes
CO1 Explain nanoscale phenomena
CO2 Describe nanomaterial synthesis
CO3 Analyze size dependent properties
CO4 Understand characterization techniques
CO5 Apply nanomaterials in devices

Detailed Syllabus

Unit I
Introduction to nanoscience; length scales; quantum confinement; surface to volume ratio; engineering relevance in electronic, optical, and mechanical property modification.

Unit II
Nanomaterial synthesis; top down and bottom up approaches; physical and chemical methods; engineering relevance in controlled nanostructure fabrication.

Unit III
Nanostructures; quantum wells, wires, dots; carbon nanotubes; graphene; engineering relevance in nanoelectronic and optoelectronic devices.

Unit IV
Characterization techniques; SEM, TEM; AFM; XRD; spectroscopy basics; engineering relevance in nanomaterial analysis and validation.

Unit V
Applications of nanomaterials; nanoelectronics; sensors; energy devices; engineering relevance in advanced technology development.

Text Books

1. Poole, C. P., & Owens, F. J. (2003). *Introduction to nanotechnology*. Wiley.
2. Kelsall, R. W., Hamley, I. W., & Geoghegan, M. (2005). *Nanoscale science and technology*. Wiley.
3. Cao, G., & Wang, Y. (2011). *Nanostructures and nanomaterials*. World Scientific.
4. Ratner, M., & Ratner, D. (2003). *Nanotechnology*. Pearson.
5. Bhushan, B. (2017). *Springer handbook of nanotechnology*. Springer.

Reference Books

1. Sattler, K. D. (2010). *Handbook of nanophysics*. CRC Press.
2. Dekker, C. (1999). *Carbon nanotubes*. Physics Today.
3. Gogotsi, Y. (2012). *Nanomaterials handbook*. CRC Press.
4. Binns, C. (2010). *Introduction to nanoscience and nanotechnology*. Wiley.
5. Tiwari, A., & Mishra, Y. K. (2016). *Advanced nanomaterials*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital System Design

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Design complex digital systems
2. Apply HDL based design concepts
3. Understand timing and synchronization
4. Design memory and control units
5. Apply digital design in systems

Course Outcomes
CO1 Design combinational circuits
CO2 Design sequential circuits
CO3 Apply HDL concepts
CO4 Analyze timing behavior
CO5 Implement digital subsystems

Detailed Syllabus

Unit I
Combinational logic design; minimization techniques; arithmetic logic units; engineering relevance in digital subsystem implementation.

Unit II
Sequential logic design; state machines; registers; counters; engineering relevance in control oriented digital systems.

Unit III
HDL concepts; behavioral and structural modeling; simulation basics; engineering relevance in digital design automation.

Unit IV
Timing analysis; clocking; synchronization; hazards; engineering relevance in reliable digital system operation.

Unit V
Memory systems; RAM, ROM organization; control units; engineering relevance in processor and embedded system design.

Text Books

1. Mano, M. M., & Ciletti, M. D. (2017). *Digital design*. Pearson.
2. Palnitkar, S. (2015). *Verilog HDL*. Pearson.
3. Brown, S., & Vranesic, Z. (2013). *Fundamentals of digital logic*. McGraw-Hill.
4. Roth, C. H., & Kinney, L. L. (2014). *Fundamentals of logic design*. Cengage.
5. Wakerly, J. F. (2006). *Digital design*. Pearson.

Reference Books

1. Harris, D. M., & Harris, S. L. (2013). *Digital design and computer architecture*. Morgan Kaufmann.
2. Katz, R. H., & Borriello, G. (2004). *Contemporary logic design*. Pearson.
3. Pucknell, D. A., & Eshraghian, K. (1994). *Basic VLSI design*. PHI.
4. Smith, M. J. S. (1997). *Application specific integrated circuits*. Addison Wesley.
5. Salivahanan, S., & Arivazhagan, S. (2018). *Digital circuits and design*. Oxford.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I (Photonics / IoT / Embedded Systems)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce interdisciplinary technologies
2. Develop application oriented knowledge
3. Encourage technology integration
4. Enhance industry relevance
5. Promote self learning

Course Outcomes
CO1 Understand elective domain concepts
CO2 Apply domain specific techniques
CO3 Analyze application scenarios
CO4 Integrate interdisciplinary knowledge
CO5 Demonstrate application capability

Guidelines
Elective specific syllabus as approved by BOS; assessment through assignments, projects, examinations

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Semiconductor Devices Laboratory

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Characterize semiconductor devices
2. Understand device parameters experimentally
3. Analyze device behavior
4. Use laboratory instruments effectively
5. Correlate theory with practice

Course Outcomes
CO1 Perform diode characterization
CO2 Analyze transistor characteristics

CO3 Measure device parameters
CO4 Interpret experimental results
CO5 Prepare technical reports

List of Experiments / Exercises

1. V I characteristics of pn junction diode using regulated power supply, multimeter, analysis of forward and reverse regions.
2. Zener diode characteristics and voltage regulation using experimental setup, load variation, regulation assessment.
3. Input and output characteristics of BJT in CE configuration using transistor test circuits, parameter extraction.
4. Input and output characteristics of JFET using biasing networks, drain characteristics evaluation.
5. MOSFET characteristics in enhancement mode using laboratory setup, threshold voltage determination.
6. Rectifier circuits performance using diodes, ripple factor measurement, efficiency calculation.
7. Clipper and clamper circuits using diodes, waveform analysis using CRO.
8. Transistor amplifier frequency response using signal generator, gain bandwidth evaluation.
9. Measurement of semiconductor resistivity using four probe method, material analysis.
10. Study of optoelectronic devices LED and photodiode using characteristic measurement setups.
11. Study of solar cell characteristics under illumination, efficiency estimation.
12. Report preparation and viva based on conducted experiments and observations.

Expected Outcomes
Experimental understanding of semiconductor devices; parameter measurement skills; data interpretation ability; professional laboratory documentation.

Evaluation Scheme
Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued industry exposure
2. Reinforce practical learning
3. Develop professional competence
4. Understand industrial workflows
5. Enhance employability

Course Outcomes
CO1 Apply engineering concepts in industry
CO2 Demonstrate professional conduct
CO3 Understand industrial processes
CO4 Communicate technical information
CO5 Submit structured internship report

Guidelines
Industry attachment; supervised training; report submission; evaluation based on performance and documentation

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER V – B.Sc. Semiconductor Devices & Nano-Electronics

Course 1: Nano-Electronic Devices

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand nanoscale device physics
2. Analyze quantum transport mechanisms
3. Study advanced nanoelectronic devices
4. Evaluate scaling and short channel effects
5. Relate nano devices to applications

Course Outcomes
CO1 Explain quantum confinement effects
CO2 Analyze carrier transport at nanoscale
CO3 Evaluate nano transistor behavior
CO4 Analyze scaling limitations
CO5 Apply nano devices in systems

Detailed Syllabus

Unit I
Nanoscale length regimes, quantum confinement effects; density of states modification; ballistic and quasi ballistic transport; scaling concepts; engineering relevance in nano device operation, performance enhancement, and technology roadmap evolution.

Unit II
Quantum transport models; Landauer formalism; tunneling mechanisms; Coulomb blockade; single electron effects; engineering relevance in ultra small devices, low power electronics, and emerging nano architectures.

Unit III
Nano MOSFETs; short channel effects; threshold voltage roll off; drain induced barrier lowering; mobility degradation; engineering relevance in device scaling, performance limits, and reliability challenges.

Unit IV
Carbon nanotube transistors; graphene based devices; nanowire transistors; material properties; fabrication concepts; engineering relevance in post silicon electronics and high performance nano systems.

Unit V
Nanoelectronic device applications; memory devices; sensors; logic applications; integration challenges; engineering relevance in future computing platforms, low power systems, and advanced electronic technologies.

Text Books

1. Ferry, D. K., & Goodnick, S. M. (2009). *Transport in nanostructures*. Cambridge University Press.
2. Datta, S. (2005). *Quantum transport*. Cambridge University Press.
3. Lundstrom, M. (2017). *Fundamentals of nanotransistors*. World Scientific.
4. Banerjee, S., & Sarkar, A. (2016). *Nanoelectronics*. CRC Press.
5. Taur, Y., & Ning, T. H. (2013). *Fundamentals of modern VLSI devices*. Cambridge University Press.

Reference Books

1. Sze, S. M., & Ng, K. K. (2007). *Physics of semiconductor devices*. Wiley.
2. Ionescu, A. M., & Riel, H. (2011). *Tunnel FETs*. Nature.
3. Bhushan, B. (2017). *Springer handbook of nanotechnology*. Springer.
4. Singh, J. (2014). *Semiconductor devices*. McGraw-Hill.
5. Kasap, S. O. (2018). *Principles of electronic materials and devices*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

VLSI Fundamentals

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand VLSI design flow
2. Analyze MOS circuit fundamentals
3. Understand CMOS logic design
4. Study fabrication constraints
5. Apply VLSI concepts

Course Outcomes
CO1 Explain VLSI design methodology

CO2 Analyze MOS circuits
CO3 Design CMOS logic
CO4 Understand layout principles
CO5 Apply VLSI techniques

Detailed Syllabus

Unit I
VLSI design methodology; hierarchy; design abstraction levels; ASIC and FPGA concepts; design flow; engineering relevance in integrated circuit development and system level integration.

Unit II
MOS transistor operation review; I V characteristics; capacitances; switching behavior; engineering relevance in digital circuit speed, power analysis, and device modeling.

Unit III
CMOS logic design; inverter characteristics; noise margins; power dissipation; delay analysis; engineering relevance in low power digital integrated circuit design.

Unit IV
Combinational and sequential CMOS circuits; logic styles; transmission gates; engineering relevance in functional block realization and performance optimization.

Unit V
VLSI layout basics; design rules; stick diagrams; scaling trends; engineering relevance in manufacturability, yield enhancement, and technology scaling.

Text Books

1. Weste, N. H. E., & Harris, D. (2011). *CMOS VLSI design*. Pearson.
2. Rabaey, J. M., Chandrakasan, A., & Nikolic, B. (2003). *Digital integrated circuits*. Pearson.
3. Kang, S. M., & Leblebici, Y. (2003). *CMOS digital integrated circuits*. McGraw-Hill.
4. Pucknell, D. A., & Eshraghian, K. (1994). *Basic VLSI design*. PHI.
5. Smith, M. J. S. (1997). *Application specific integrated circuits*. Addison Wesley.

Reference Books

1. Baker, R. J. (2010). *CMOS circuit design*. Wiley.
2. Veendrick, H. (2017). *Deep submicron CMOS ICs*. Springer.
3. Mead, C., & Conway, L. (1980). *Introduction to VLSI systems*. Addison Wesley.
4. Rutenbar, R. A. (2015). *VLSI CAD*. McGraw-Hill.
5. Lim, S. K. (2014). *Practical problems in VLSI physical design*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Semiconductor Manufacturing Processes

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand semiconductor manufacturing flow
2. Study wafer processing techniques
3. Analyze process control concepts
4. Understand yield and reliability
5. Relate processes to devices

Course Outcomes
CO1 Explain manufacturing steps
CO2 Analyze process techniques
CO3 Understand process control
CO4 Evaluate yield factors
CO5 Relate processes to performance

Detailed Syllabus

Unit I
Semiconductor manufacturing overview; wafer preparation; crystal growth; slicing; polishing; cleaning; engineering relevance in substrate quality, defect reduction, and device yield improvement.

Unit II
Oxidation and diffusion processes; ion implantation; annealing; process parameters; engineering relevance in junction formation, dopant profiling, and electrical property control.

Unit III
Lithography processes; photoresists; exposure systems; alignment; resolution; engineering relevance in critical dimension control and pattern fidelity.

Unit IV
Etching and deposition; wet and dry etching; CVD, PVD; metallization; engineering relevance in interconnect formation and multilayer integration.

Unit V
Process integration; yield enhancement; reliability considerations; cleanroom practices; engineering relevance in large scale manufacturing and cost effective production.

Text Books

1. Campbell, S. A. (2008). *The science and engineering of microelectronic fabrication*. Oxford.
2. Jaeger, R. C. (2002). *Introduction to microelectronic fabrication*. Pearson.
3. Wolf, S., & Tauber, R. N. (2000). *Silicon processing for the VLSI era*. Lattice Press.
4. Madou, M. J. (2011). *Fundamentals of microfabrication*. CRC Press.
5. Van Zant, P. (2014). *Microchip fabrication*. McGraw-Hill.

Reference Books

1. Sze, S. M., & Ng, K. K. (2007). *Physics of semiconductor devices*. Wiley.
2. Plummer, J. D., Deal, M., & Griffin, P. (2000). *Silicon VLSI technology*. Prentice Hall.
3. Chang, S. T. (2016). *Semiconductor manufacturing handbook*. McGraw-Hill.
4. Jaeger, R. C., & Blalock, T. N. (2010). *Microelectronic circuit design*. McGraw-Hill.
5. May, G. S., & Spanos, C. J. (2006). *Fundamentals of semiconductor manufacturing*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Optoelectronic Devices

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand light matter interaction
2. Study optoelectronic device physics
3. Analyze optical sources and detectors
4. Understand optical communication basics
5. Apply optoelectronic devices

Course Outcomes
CO1 Explain optical properties
CO2 Analyze LEDs and lasers
CO3 Analyze photodetectors
CO4 Understand optical systems
CO5 Apply optoelectronic devices

Detailed Syllabus

Unit I
Optical properties of semiconductors; absorption; emission; recombination processes; engineering relevance in optoelectronic device efficiency and spectral response.

Unit II
Light emitting diodes; structure; characteristics; materials; efficiency; engineering relevance in displays, indicators, and solid state lighting.

Unit III
Laser diodes; population inversion; optical resonators; threshold conditions; engineering relevance in optical communication and sensing systems.

Unit IV
Photodetectors; photodiodes; PIN and avalanche photodiodes; characteristics; engineering relevance in optical receivers and measurement systems.

Unit V
Optoelectronic applications; optical communication basics; fiber coupling; system considerations; engineering relevance in high speed data transmission.

Text Books

1. Saleh, B. E. A., & Teich, M. C. (2007). *Fundamentals of photonics*. Wiley.
2. Senior, J. M. (2009). *Optical fiber communications*. Pearson.
3. Singh, J. (2014). *Optoelectronic devices*. McGraw-Hill.
4. Wilson, J., & Hawkes, J. (2000). *Optoelectronics*. Prentice Hall.
5. Agrawal, G. P. (2012). *Fiber optic communication systems*. Wiley.

Reference Books

1. Ghatak, A. K., & Thyagarajan, K. (2009). *Introduction to fiber optics*. Cambridge.
2. Sze, S. M. (2001). *Physics of semiconductor devices*. Wiley.
3. Yariv, A., & Yeh, P. (2007). *Photonics*. Oxford.
4. Keiser, G. (2010). *Optical fiber communications*. McGraw-Hill.
5. Kasap, S. O. (2018). *Principles of electronic materials and devices*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I (MEMS / Power Semiconductor Devices)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide specialization knowledge
2. Understand elective domain fundamentals
3. Analyze device operation
4. Study applications
5. Develop domain expertise

Course Outcomes
CO1 Explain elective domain concepts
CO2 Analyze device behavior
CO3 Apply devices in applications
CO4 Evaluate performance parameters
CO5 Demonstrate specialization knowledge

Guidelines
Elective specific syllabus as approved by BOS; evaluation through assignments, examinations, and projects

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Course 6: Minor Project (Device Characterization / Simulation)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply theoretical knowledge
2. Develop problem solving skills
3. Perform device characterization or simulation
4. Develop documentation skills
5. Encourage independent learning

Course Outcomes
CO1 Define project objectives
CO2 Apply analytical tools

CO3 Perform experimentation or simulation
CO4 Analyze results
CO5 Prepare technical reports

Guidelines
Problem identification; literature review; experimentation or simulation; report preparation; presentation and evaluation

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VI – B.Sc. Semiconductor Devices & Nano-Electronics

Course 1: Advanced Semiconductor Devices

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand advanced device structures
2. Analyze high performance semiconductor devices
3. Study power and high frequency devices
4. Understand reliability and scaling issues
5. Relate advanced devices to applications

Course Outcomes
CO1 Explain advanced semiconductor device concepts
CO2 Analyze high frequency device behavior
CO3 Evaluate power semiconductor devices
CO4 Analyze reliability and degradation mechanisms
CO5 Apply advanced devices in systems

Detailed Syllabus

Unit I
Advanced pn junction concepts; heterojunctions; band alignment; wide band gap semiconductors; engineering relevance in high power, high temperature, and high frequency electronic applications.

Unit II
Bipolar and MOS advanced devices; HBTs, HEMTs; device structures; operating principles; engineering relevance in RF circuits, microwave systems, and high speed electronics.

Unit III
Power semiconductor devices; power diodes; MOSFETs; IGBTs; characteristics; switching behavior; engineering relevance in power conversion and energy systems.

Unit IV
Device reliability; breakdown mechanisms; hot carrier effects; oxide degradation; thermal effects; engineering relevance in lifetime prediction and robust device design.

Unit V
Scaling challenges; short channel effects; variability; emerging materials; engineering relevance in advanced technology nodes and future semiconductor devices.

Text Books

1. Sze, S. M., & Ng, K. K. (2007). *Physics of semiconductor devices*. Wiley.
2. Taur, Y., & Ning, T. H. (2013). *Fundamentals of modern VLSI devices*. Cambridge University Press.
3. Singh, J. (2014). *Semiconductor devices*. McGraw-Hill.
4. Neamen, D. A. (2012). *Semiconductor physics and devices*. McGraw-Hill.
5. Streetman, B. G., & Banerjee, S. (2016). *Solid state electronic devices*. Pearson.

Reference Books

1. Pierret, R. F. (2003). *Semiconductor device fundamentals*. Pearson.
2. Kasap, S. O. (2018). *Principles of electronic materials and devices*. McGraw-Hill.
3. Ionescu, A. M., & Riel, H. (2011). *Tunnel field effect transistors*. Nature.
4. Madou, M. J. (2011). *Fundamentals of microfabrication*. CRC Press.
5. Wolf, S., & Tauber, R. N. (2000). *Silicon processing for the VLSI era*. Lattice Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Packaging, Testing & Reliability of Devices

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand semiconductor packaging technologies
2. Study device testing methods
3. Analyze reliability and failure mechanisms
4. Understand thermal and mechanical effects
5. Relate packaging to device performance

Course Outcomes
CO1 Explain packaging techniques
CO2 Analyze device testing procedures
CO3 Identify failure mechanisms
CO4 Evaluate reliability parameters
CO5 Apply packaging knowledge in design

Detailed Syllabus

Unit I
Semiconductor packaging overview; through hole and surface mount packages; chip carriers; engineering relevance in device protection, interconnection, and performance optimization.

Unit II
Advanced packaging technologies; multichip modules; system in package; wafer level packaging; engineering relevance in miniaturization and high density integration.

Unit III
Device testing methods; wafer probing; functional testing; parametric testing; engineering relevance in quality assurance and yield improvement.

Unit IV
Reliability engineering; failure mechanisms; thermal cycling; electromigration; stress testing; engineering relevance in lifetime prediction and reliability enhancement.

Unit V
Thermal management; heat dissipation; thermal resistance; mechanical stress; engineering relevance in high power device packaging and system reliability.

Text Books

1. Tummala, R. R. (2001). *Fundamentals of microsystems packaging*. McGraw-Hill.
2. Harper, C. A. (2004). *Electronic packaging and interconnection handbook*. McGraw-Hill.
3. Pecht, M. (2009). *Reliability physics and engineering*. Wiley.
4. Jaeger, R. C. (2002). *Introduction to microelectronic fabrication*. Pearson.
5. May, G. S., & Spanos, C. J. (2006). *Fundamentals of semiconductor manufacturing*. Wiley.

Reference Books

1. Sze, S. M. (2001). *Semiconductor devices*. Wiley.
2. Chang, S. T. (2016). *Semiconductor manufacturing handbook*. McGraw-Hill.
3. Lau, J. H. (2012). *Chip scale package*. McGraw-Hill.
4. Geng, H. (2017). *Semiconductor device reliability*. Wiley.
5. Lall, P. (2010). *Reliability of electronic packaging*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Emerging Trends in Nano-Electronics

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce emerging nanoelectronic technologies
2. Study novel materials and devices
3. Analyze future computing paradigms
4. Understand research and industry trends
5. Encourage technology awareness

Course Outcomes
CO1 Explain emerging nanoelectronic concepts
CO2 Analyze novel device structures
CO3 Understand future technology directions
CO4 Relate research trends to applications
CO5 Demonstrate awareness of advancements

Detailed Syllabus

Unit I
Emerging nanoelectronic landscape; scaling limits; beyond CMOS concepts; engineering relevance in next generation electronic systems and research directions.

Unit II
Two dimensional materials; graphene; transition metal dichalcogenides; properties; engineering relevance in ultra thin electronic and optoelectronic devices.

Unit III
Spintronics and quantum devices; spin transport; quantum bits; engineering relevance in low power computing and quantum information processing.

Unit IV
Flexible and wearable electronics; organic semiconductors; fabrication concepts; engineering relevance in biomedical and consumer applications.

Unit V
Industry and research trends; technology roadmaps; sustainability; engineering relevance in future workforce preparation and innovation ecosystems.

Text Books

1. Datta, S. (2005). *Quantum transport*. Cambridge University Press.
2. Bhushan, B. (2017). *Springer handbook of nanotechnology*. Springer.

3. Ionescu, A. M., & Riel, H. (2011). *Tunnel field effect transistors*. Nature.
4. Kasap, S. O. (2018). *Principles of electronic materials and devices*. McGraw-Hill.
5. Lundstrom, M. (2017). *Fundamentals of nanotransistors*. World Scientific.

Reference Books

1. Sattler, K. D. (2010). *Handbook of nanophysics*. CRC Press.
2. Gogotsi, Y. (2012). *Nanomaterials handbook*. CRC Press.
3. Cao, G., & Wang, Y. (2011). *Nanostructures and nanomaterials*. World Scientific.
4. Tiwari, A., & Mishra, Y. K. (2016). *Advanced nanomaterials*. Wiley.
5. Banerjee, S., & Sarkar, A. (2016). *Nanoelectronics*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II (AI for Electronics / Renewable Energy Devices)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide interdisciplinary exposure
2. Introduce advanced application domains
3. Develop analytical skills
4. Enhance employability
5. Encourage self learning

Course Outcomes
CO1 Understand elective domain fundamentals
CO2 Apply interdisciplinary techniques
CO3 Analyze application scenarios
CO4 Integrate electronics with allied fields
CO5 Demonstrate applied knowledge

Guidelines
Elective specific syllabus as approved by BOS; assessment through assignments, projects, and examinations

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project (Industry / Research Based)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Solve complex engineering problems
2. Apply research or industrial methodologies
3. Develop system design skills
4. Enhance documentation and presentation ability
5. Prepare for professional practice

Course Outcomes
CO1 Identify and define project problems
CO2 Apply appropriate tools and techniques
CO3 Design and implement solutions
CO4 Analyze results critically
CO5 Present and document project work

Guidelines
Problem identification; literature survey; design and implementation; testing and validation; dissertation submission; evaluation through reviews, report, and viva voce

Evaluation Scheme
Continuous Assessment (100%)

Seminar / Viva-Voce

Course Category: Project Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical communication skills
2. Enhance literature survey capability
3. Improve presentation skills
4. Prepare for professional discussions
5. Assess overall program learning

Course Outcomes
CO1 Conduct technical literature survey
CO2 Prepare structured seminar report

CO3 Deliver effective technical presentation
CO4 Respond to technical queries
CO5 Demonstrate comprehensive program knowledge

Guidelines
Seminar topic selection; literature review; report preparation; presentation; viva voce examination

Evaluation Scheme
Continuous Assessment (100%)

B.Sc. – Robotronics

Duration: 3 Years | 6 Semesters | Total Credits: 120

SEMESTER I

Mathematics I (Calculus & Linear Algebra)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical foundations required for engineering problem solving
2. Build competence in differential and integral calculus techniques
3. Introduce linear algebra concepts relevant to engineering systems
4. Apply mathematical tools to physical and engineering models
5. Strengthen analytical and logical reasoning skills

Course Outcomes

- CO1: Apply limits and continuity concepts to engineering problems
- CO2: Solve problems using differential calculus techniques
- CO3: Evaluate integrals and apply them to physical systems
- CO4: Use matrices and determinants in engineering applications
- CO5: Solve systems of linear equations using linear algebra methods

Detailed Syllabus

Unit I
Functions, limits, continuity, differentiability; standard limits, algebra of limits; continuity conditions, piecewise functions; engineering significance of continuity; basic functional modeling, graphical interpretation, rate variation concepts, mathematical consistency, physical system approximation, analytical foundations.

Unit II
Differentiation techniques, implicit differentiation, parametric differentiation; higher order derivatives, Leibniz theorem; applications to maxima and minima, curvature, radius of curvature; optimization in engineering systems, sensitivity analysis, rate of change modeling.

Unit III
Indefinite integrals, standard integrals, substitution, partial fractions; definite integrals,

properties, evaluation techniques; applications to area, volume, engineering measurements; integral modeling, accumulation processes, physical interpretation, computational relevance.

Unit IV
Matrices, types of matrices, matrix operations; determinants, properties, minors, cofactors; inverse of matrices, rank; solution of linear equations using matrix methods; engineering system representation, network equations, computational efficiency.

Unit V
Eigenvalues and eigenvectors, characteristic equations; diagonalization of matrices; applications in engineering systems, stability analysis, vibration problems; introduction to vector spaces, linear transformations, practical relevance in robotics and automation.

Text Books

1. Kreyszig, E. (2011). *Advanced engineering mathematics* (10th ed.). John Wiley & Sons.
2. Jain, R. K., & Iyengar, S. R. K. (2014). *Advanced engineering mathematics*. Narosa Publishing House.
3. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' calculus* (14th ed.). Pearson Education.
4. Anton, H., Bivens, I., & Davis, S. (2016). *Calculus* (10th ed.). Wiley.
5. Strang, G. (2016). *Introduction to linear algebra* (5th ed.). Wellesley-Cambridge Press.

Reference Books

1. Erwin, K. (2012). *Advanced engineering mathematics* (10th ed.). Wiley India.
2. Poole, D. (2015). *Linear algebra: A modern introduction* (4th ed.). Cengage Learning.
3. Simmons, G. F. (2017). *Differential equations with applications and historical notes* (3rd ed.). CRC Press.
4. Ayres, F., & Mendelson, E. (2014). *Schaum's outline of calculus*. McGraw-Hill.
5. Lipschutz, S., & Lipson, M. (2013). *Linear algebra* (4th ed.). McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Physics I (Mechanics & Sensors)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamental principles of classical mechanics
2. Analyze motion and force systems relevant to engineering
3. Introduce sensing principles used in engineering applications
4. Correlate physical laws with sensor-based measurements
5. Build experimental and analytical physics foundations

Course Outcomes

- CO1: Apply laws of mechanics to engineering systems
- CO2: Analyze motion using kinematic and dynamic principles
- CO3: Understand work, energy, and power relationships
- CO4: Explain principles of common engineering sensors
- CO5: Apply physics concepts to robotics-related measurements

Detailed Syllabus

Unit I
Units, dimensions, measurement standards; errors, accuracy, precision; vectors, scalars; laws of motion, inertial and non-inertial frames; engineering relevance of mechanics, force systems, translational motion analysis.

Unit II
Work, energy, power; conservative and non-conservative forces; potential energy, kinetic energy; energy conservation; engineering applications, mechanical system efficiency, energy transfer mechanisms, practical motion analysis.

Unit III
Rotational mechanics, torque, angular momentum; moment of inertia, parallel and perpendicular axis theorems; rotational kinetic energy; gyroscopic effects, engineering applications, stability of rotating systems.

Unit IV
Oscillations, simple harmonic motion; damped and forced oscillations; resonance phenomena; vibration analysis in mechanical systems; engineering relevance in robotics structures and sensor mounting.

Unit V
Sensors and transducers, classification; displacement, force, pressure sensors; working

principles, characteristics, sensitivity; applications in robotics, measurement systems, signal conditioning relevance.

Text Books

1. Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.
2. Serway, R. A., & Jewett, J. W. (2017). *Physics for scientists and engineers* (9th ed.). Cengage Learning.
3. Gaur, R. K., & Gupta, S. L. (2015). *Engineering physics*. Dhanpat Rai Publications.
4. Rajput, B. S. (2014). *Applied physics*. Laxmi Publications.
5. Arora, S. L., & Singh, S. (2016). *Sensors and transducers*. PHI Learning.

Reference Books

1. Tipler, P. A., & Mosca, G. (2014). *Physics for scientists and engineers*. W.H. Freeman.
2. Beiser, A. (2013). *Concepts of modern physics*. McGraw-Hill.
3. Bolton, W. (2015). *Instrumentation and control systems*. Elsevier.
4. Doebelin, E. O. (2011). *Measurement systems*. McGraw-Hill.
5. Fraden, J. (2016). *Handbook of modern sensors* (5th ed.). Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Chemistry / Environmental Science

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand chemical principles relevant to engineering
2. Study materials chemistry and corrosion mechanisms
3. Introduce environmental science fundamentals
4. Analyze sustainability and environmental protection methods
5. Build awareness of chemical safety and green practices

Course Outcomes

- CO1: Apply basic chemistry concepts to engineering materials

- CO2: Explain corrosion and its prevention techniques
- CO3: Understand water chemistry and treatment methods
- CO4: Analyze environmental pollution and control strategies
- CO5: Apply sustainability principles in engineering practice

Detailed Syllabus

Unit I
Atomic structure, periodic properties; chemical bonding, molecular structure; intermolecular forces; relevance to material properties; engineering material behavior, bonding strength, chemical stability considerations.

Unit II
Electrochemistry, electrode potentials; corrosion mechanisms, galvanic and electrochemical corrosion; corrosion prevention techniques; coatings, inhibitors; engineering material protection strategies.

Unit III
Water chemistry, hardness, alkalinity; water treatment processes; desalination methods; industrial water requirements; boiler feed water chemistry, scaling prevention.

Unit IV
Environmental pollution, air, water, soil pollution; sources, effects; pollution control technologies; waste management; environmental regulations, sustainable engineering practices.

Unit V
Green chemistry principles; renewable resources; environmental impact assessment; sustainable development goals; engineering responsibility toward environment, safety, ethical compliance.

Text Books

1. Jain, P. C., & Jain, M. (2016). *Engineering chemistry*. Dhanpat Rai Publishing.
2. Dara, S. S., & Dara, S. (2014). *Engineering chemistry*. S. Chand.
3. Anil Kumar, V., & Raghunathan, V. (2018). *Environmental science and engineering*. Wiley India.
4. Peavy, H. S., & Row, R. (2013). *Environmental engineering*. McGraw-Hill.
5. Manahan, S. E. (2017). *Environmental chemistry*. CRC Press.

Reference Books

1. Bansal, R. K. (2015). *Engineering chemistry*. Laxmi Publications.

2. Sawyer, C. N., McCarty, P. L., & Parkin, G. (2012). *Chemistry for environmental engineering*. McGraw-Hill.
3. Atkins, P., & de Paula, J. (2018). *Physical chemistry*. Oxford University Press.
4. Lancaster, M. (2016). *Green chemistry*. Royal Society of Chemistry.
5. Masters, G. M., & Ela, W. (2014). *Introduction to environmental engineering*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Introduction to Programming (C / Python)

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamental programming concepts
2. Develop algorithmic thinking and problem solving
3. Learn structured programming using C or Python
4. Apply programming for engineering computations
5. Prepare foundation for advanced robotics programming

Course Outcomes

- CO1: Write basic programs using control structures
- CO2: Develop algorithms for problem solving
- CO3: Use arrays and functions effectively
- CO4: Apply programming to engineering applications
- CO5: Debug and test simple programs

Detailed Syllabus

Unit I
Programming fundamentals, algorithms, flowcharts; program structure; variables, data types; input output statements; compilation and execution process; problem solving approach, computational thinking basics.

Unit II
Operators, expressions; conditional statements; looping constructs; iteration control; logical flow management; program efficiency considerations; practical coding practices.

Unit III
Arrays, strings; memory organization; array operations; string manipulation; engineering data handling; structured data processing techniques.

Unit IV
Functions, parameter passing; recursion concepts; modular programming; scope of variables; program reuse; engineering computation structuring.

Unit V
Basic file handling; introduction to libraries; simple applications in engineering calculations; error handling basics; program testing and debugging strategies.

Text Books

1. Kernighan, B. W., & Ritchie, D. M. (2015). *The C programming language*. Pearson.
2. Reema Thareja. (2018). *Programming in C*. Oxford University Press.
3. Guttag, J. V. (2016). *Introduction to computation and programming using Python*. MIT Press.
4. Zelle, J. M. (2017). *Python programming*. Franklin, Beedle & Associates.
5. Kanetkar, Y. (2019). *Let us C*. BPB Publications.

Reference Books

1. Deitel, P., & Deitel, H. (2014). *C how to program*. Pearson.
2. Downey, A. B. (2015). *Think Python*. O'Reilly Media.
3. Lutz, M. (2013). *Learning Python*. O'Reilly Media.
4. Schildt, H. (2017). *C complete reference*. McGraw-Hill.
5. Allen, D. (2018). *Python crash course*. No Starch Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Basics of Electrical & Electronics Engineering

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand basic electrical circuit principles
2. Learn fundamentals of electronic components
3. Analyze DC and AC circuits

4. Introduce power and energy concepts
5. Build foundation for robotics electronics

Course Outcomes

- CO1: Analyze simple electrical circuits
- CO2: Apply circuit laws to problem solving
- CO3: Understand semiconductor device basics
- CO4: Explain AC fundamentals
- CO5: Relate electrical concepts to robotics systems

Detailed Syllabus

Unit I
Electrical quantities, units; Ohm's law; Kirchhoff laws; series and parallel circuits; energy and power; engineering circuit analysis fundamentals.

Unit II
DC circuits, network theorems; source transformation; transient response basics; practical circuit evaluation techniques.

Unit III
AC fundamentals, sinusoidal waveforms; RMS values; impedance; single phase AC circuits; power factor concepts.

Unit IV
Semiconductor materials; PN junction diode; rectifiers; Zener diode applications; basic electronic circuit understanding.

Unit V
Introduction to transistors; BJT, MOSFET basics; amplification concepts; power supplies; engineering relevance in robotics electronics.

Text Books

1. Hughes, E. (2016). *Electrical and electronic technology*. Pearson.
2. Theraja, B. L., & Theraja, A. K. (2014). *A textbook of electrical technology*. S. Chand.
3. Boylestad, R. L., & Nashelsky, L. (2015). *Electronic devices and circuit theory*. Pearson.
4. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic circuits*. Oxford University Press.
5. Del Toro, V. (2013). *Electrical engineering fundamentals*. Prentice Hall.

Reference Books

1. Alexander, C. K., & Sadiku, M. N. O. (2017). *Fundamentals of electric circuits*. McGraw-Hill.
2. Floyd, T. L. (2015). *Electronic devices*. Pearson.
3. Nilsson, J. W., & Riedel, S. (2014). *Electric circuits*. Pearson.
4. Gussow, M. (2012). *Schaum's outline of basic electricity*. McGraw-Hill.
5. Dorf, R. C., & Svoboda, J. A. (2014). *Introduction to electric circuits*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop professional communication competence
2. Improve technical reading and writing skills
3. Enhance presentation and interpersonal skills
4. Build workplace communication readiness
5. Strengthen confidence in professional environments

Course Outcomes

- CO1: Communicate effectively in professional contexts
- CO2: Write structured technical documents
- CO3: Deliver organized oral presentations
- CO4: Apply interpersonal communication skills
- CO5: Demonstrate workplace communication etiquette

Detailed Syllabus

Unit I
Basics of communication; verbal and non-verbal communication; listening skills; barriers to communication; professional relevance.

Unit II
Technical vocabulary; reading comprehension; interpretation of technical texts; summarization techniques; information structuring.

Unit III
Technical writing fundamentals; reports, emails; clarity, coherence; professional documentation standards.

Unit IV
Oral communication; presentations; group discussions; interview skills; public speaking fundamentals.

Unit V
Professional ethics; workplace communication; cross-cultural communication; corporate etiquette; teamwork skills.

Text Books

1. Meenakshi Raman, & Sangeeta Sharma. (2017). *Technical communication*. Oxford University Press.
2. Bovee, C. L., & Thill, J. V. (2016). *Business communication today*. Pearson.
3. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2015). *Business communication*. McGraw-Hill.
4. Murphy, R. (2019). *English grammar in use*. Cambridge University Press.
5. Guffey, M. E. (2018). *Business communication*. Cengage Learning.

Reference Books

1. Rizvi, M. A. (2014). *Effective technical communication*. McGraw-Hill.
2. Eastwood, J. (2016). *Oxford guide to English grammar*. Oxford University Press.
3. Chaney, L. H., & Martin, J. S. (2017). *Intercultural business communication*. Pearson.
4. Lucas, S. E. (2015). *The art of public speaking*. McGraw-Hill.
5. Peacock, M. (2016). *English for engineering students*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Laboratory Practice I (Physics / Electronics)

Course Category: Engineering Science Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Reinforce physics and electronics concepts through experiments
2. Develop hands-on measurement skills
3. Learn safe laboratory practices
4. Improve data recording and analysis skills
5. Build experimental discipline

Course Outcomes

- CO1: Perform basic physics and electronics experiments
- CO2: Use laboratory instruments correctly
- CO3: Record and analyze experimental data
- CO4: Interpret results with theoretical concepts
- CO5: Follow laboratory safety procedures

List of Experiments / Exercises

1. Determination of acceleration due to gravity using pendulum setup, time measurement techniques, error analysis, and result interpretation for mechanical motion understanding.
2. Verification of Ohm's law using resistive circuits, multimeter measurements, voltage current analysis, and graphical representation of linear characteristics.
3. Measurement of resistance using Wheatstone bridge, balancing techniques, sensitivity analysis, and precision evaluation.
4. Study of series and parallel circuits using DC power supply, current distribution analysis, and equivalent resistance calculation.
5. Characteristics of PN junction diode under forward and reverse bias, curve plotting, threshold voltage determination, and device behavior interpretation.
6. Zener diode characteristics and voltage regulation study, regulation performance evaluation, and application understanding.
7. Measurement of capacitance using RC circuits, time constant calculation, and transient response observation.

8. Study of CRO for voltage, frequency measurement, waveform analysis, and signal interpretation.
9. Calibration of basic laboratory instruments, accuracy verification, and uncertainty estimation.
10. Laboratory safety practices, equipment handling, experimental documentation, and reporting standards.

Expected Outcomes
Practical competence in basic physics and electronics experiments, improved measurement accuracy, safe laboratory behavior, and strengthened theoretical understanding through experimentation.

Evaluation Scheme
Continuous Assessment (60%) + End-SEMESTER Practical Examination (40%)

SEMESTER II

Mathematics II (Probability & Statistics)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop understanding of probability theory fundamentals
2. Apply random variable concepts to engineering problems
3. Analyze statistical data using descriptive measures
4. Understand probability distributions relevant to engineering
5. Apply statistical methods for decision making

Course Outcomes

- CO1: Apply probability concepts to engineering scenarios
- CO2: Analyze discrete and continuous random variables
- CO3: Use probability distributions in engineering analysis
- CO4: Apply statistical methods for data interpretation
- CO5: Perform hypothesis testing and inferential analysis

Detailed Syllabus

Unit I
Probability concepts, sample space, events; axioms of probability; conditional probability, Bayes theorem; random experiments, engineering uncertainty modeling, probabilistic reasoning, reliability estimation fundamentals.

Unit II
Random variables, discrete and continuous types; probability mass and density functions; distribution functions; expectation, variance, moments; engineering data modeling, uncertainty quantification techniques.

Unit III
Discrete probability distributions; binomial, Poisson distributions; mean, variance properties; applications in quality control, reliability analysis, engineering event modeling, discrete system behavior analysis.

Unit IV
Continuous probability distributions; normal, exponential distributions; properties,

applications; standard normal variable; engineering tolerance analysis, noise modeling, life data interpretation.

Unit V
Statistics fundamentals; measures of central tendency, dispersion; correlation, regression analysis; hypothesis testing basics; confidence intervals; engineering decision making, data driven inference.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and statistics for engineers and scientists* (9th ed.). Pearson.
2. Devore, J. L. (2015). *Probability and statistics for engineering and the sciences* (8th ed.). Cengage Learning.
3. Gupta, S. C., & Kapoor, V. K. (2014). *Fundamentals of mathematical statistics*. Sultan Chand.
4. Montgomery, D. C., & Runger, G. C. (2018). *Applied statistics and probability for engineers* (7th ed.). Wiley.
5. Ross, S. M. (2014). *Introduction to probability models*. Academic Press.

Reference Books

1. Hogg, R. V., McKean, J., & Craig, A. (2019). *Introduction to mathematical statistics*. Pearson.
2. Spiegel, M. R., & Stephens, L. J. (2017). *Schaum's outline of statistics*. McGraw-Hill.
3. Johnson, R. A., & Bhattacharyya, G. K. (2015). *Statistics: Principles and methods*. Wiley.
4. Navidi, W. (2016). *Statistics for engineers and scientists*. McGraw-Hill.
5. Papoulis, A., & Pillai, S. U. (2014). *Probability, random variables, and stochastic processes*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Physics II (Electromagnetism & Modern Physics)

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand electromagnetic field principles

2. Apply Maxwell's equations to engineering systems
3. Introduce modern physics concepts
4. Relate electromagnetic theory to device applications
5. Build foundation for advanced electronics and robotics

Course Outcomes

- CO1: Apply electrostatic and magnetic field concepts
- CO2: Analyze electromagnetic induction phenomena
- CO3: Understand Maxwell's equations and applications
- CO4: Explain modern physics principles
- CO5: Relate physics concepts to engineering devices

Detailed Syllabus

Unit I
Electrostatics, Coulomb law; electric field, flux, Gauss law; electric potential, capacitance; dielectric materials; engineering field analysis, energy storage principles.

Unit II
Magnetostatics, magnetic field, Biot Savart law; Ampere law; magnetic materials; force on moving charges; engineering applications in motors and actuators.

Unit III
Electromagnetic induction, Faraday laws; self and mutual inductance; energy stored in magnetic fields; transient response; engineering relevance in power and signal systems.

Unit IV
Maxwell equations, displacement current; electromagnetic wave propagation; Poynting vector; waveguides basics; communication and sensing applications.

Unit V
Modern physics introduction; quantum concepts; photoelectric effect; semiconductors basics; engineering relevance in electronic and optoelectronic devices.

Text Books

1. Griffiths, D. J. (2017). *Introduction to electrodynamics* (4th ed.). Pearson.
2. Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics*. Wiley.
3. Serway, R. A., & Jewett, J. W. (2017). *Physics for scientists and engineers*. Cengage.
4. Gaur, R. K., & Gupta, S. L. (2016). *Engineering physics*. Dhanpat Rai.
5. Streetman, B. G., & Banerjee, S. (2016). *Solid state electronic devices*. Pearson.

Reference Books

1. Hayt, W. H., & Buck, J. A. (2019). *Engineering electromagnetics*. McGraw-Hill.
2. Tipler, P. A., & Llewellyn, R. (2013). *Modern physics*. W.H. Freeman.
3. Beiser, A. (2014). *Concepts of modern physics*. McGraw-Hill.
4. Sadiku, M. N. O. (2018). *Elements of electromagnetics*. Oxford.
5. Kittel, C. (2018). *Introduction to solid state physics*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Electronics Fundamentals

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand digital number systems and logic
2. Analyze combinational and sequential circuits
3. Learn logic gate implementation
4. Introduce digital ICs and memory
5. Build foundation for embedded systems

Course Outcomes

- CO1: Convert and operate on number systems
- CO2: Design combinational logic circuits
- CO3: Analyze sequential logic circuits
- CO4: Understand digital IC functionality
- CO5: Apply digital concepts in engineering systems

Detailed Syllabus

Unit I
Number systems, binary, octal, hexadecimal; conversions; binary arithmetic; signed numbers; engineering relevance of digital representation.

Unit II
Logic gates, Boolean algebra; De Morgan theorems; logic simplification; Karnaugh maps; combinational circuit design principles.

Unit III
Combinational circuits; adders, subtractors, encoders, decoders; multiplexers, demultiplexers; engineering digital system applications.

Unit IV
Sequential logic circuits; flip flops, latches; counters, registers; timing diagrams; clocking concepts; system synchronization.

Unit V
Memory devices; ROM, RAM types; introduction to programmable logic devices; digital IC characteristics; system integration relevance.

Text Books

1. Morris Mano, M., & Ciletti, M. D. (2017). *Digital design*. Pearson.
2. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2016). *Digital systems*. Pearson.
3. Floyd, T. L. (2015). *Digital fundamentals*. Pearson.
4. Gothmann, W. H. (2014). *Digital electronics*. PHI.
5. Jain, R. P. (2016). *Modern digital electronics*. McGraw-Hill.

Reference Books

1. Brown, S., & Vranesic, Z. (2014). *Fundamentals of digital logic*. McGraw-Hill.
2. Katz, R. H., & Borriello, G. (2015). *Contemporary logic design*. Pearson.
3. Roth, C. H., & Kinney, L. L. (2016). *Fundamentals of logic design*. Cengage.
4. Leach, D. P., & Malvino, A. (2017). *Digital principles and applications*. McGraw-Hill.
5. Wakerly, J. F. (2018). *Digital design principles*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Mechanics

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand force systems and equilibrium
2. Analyze structures and mechanical components
3. Apply laws of motion to particles and bodies

4. Study friction and its engineering applications
5. Build mechanical analysis foundation for robotics

Course Outcomes

- CO1: Analyze coplanar force systems
- CO2: Apply equilibrium conditions to bodies
- CO3: Understand kinematics of particles
- CO4: Analyze frictional effects
- CO5: Apply mechanics to engineering problems

Detailed Syllabus

Unit I
Statics fundamentals; force systems; resultant and equilibrium; free body diagrams; engineering structure analysis basics.

Unit II
Trusses, frames, beams; analysis methods; reactions and internal forces; engineering structural relevance.

Unit III
Kinematics of particles; rectilinear and curvilinear motion; velocity and acceleration; engineering motion analysis.

Unit IV
Kinetics of particles; Newton laws; work energy principles; impulse momentum; engineering dynamic systems.

Unit V
Friction; laws of friction; belt friction; rolling resistance; engineering applications in machines and robotics.

Text Books

1. Hibbeler, R. C. (2016). *Engineering mechanics: Statics and dynamics*. Pearson.
2. Bansal, R. K. (2014). *Engineering mechanics*. Laxmi Publications.
3. Beer, F. P., Johnston, E. R., & Mazurek, D. (2018). *Vector mechanics for engineers*. McGraw-Hill.
4. Timoshenko, S., & Young, D. H. (2015). *Engineering mechanics*. McGraw-Hill.
5. Meriam, J. L., & Kraige, L. G. (2017). *Engineering mechanics*. Wiley.

Reference Books

1. Popov, E. P. (2016). *Engineering mechanics of solids*. Pearson.

2. Gere, J. M., & Goodno, B. J. (2015). *Mechanics of materials*. Cengage.
3. Riley, W. F., & Sturges, L. D. (2014). *Engineering mechanics*. Wiley.
4. Boresi, A. P., & Schmidt, R. J. (2017). *Advanced mechanics of materials*. Wiley.
5. Bedford, A., & Fowler, W. (2014). *Engineering mechanics*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Materials Science for Robotics

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand material structure and properties
2. Relate materials to robotic applications
3. Study metals, polymers, ceramics, composites
4. Analyze mechanical and thermal properties
5. Select materials for engineering design

Course Outcomes

- CO1: Explain atomic structure and bonding
- CO2: Analyze material properties
- CO3: Compare engineering materials
- CO4: Apply materials selection principles
- CO5: Relate materials to robotics systems

Detailed Syllabus

Unit I
Atomic structure, bonding; crystal structures; defects; material properties correlation; engineering material behavior fundamentals.

Unit II
Mechanical properties; stress strain behavior; hardness, toughness; testing methods; engineering relevance.

Unit III
Metallic materials; ferrous and nonferrous alloys; properties, applications; robotics structural components.

Unit IV
Polymers, ceramics, composites; properties; processing methods; lightweight engineering applications.

Unit V
Smart materials; shape memory alloys; piezoelectric materials; robotics and automation applications.

Text Books

1. Callister, W. D., & Rethwisch, D. (2018). *Materials science and engineering*. Wiley.
2. Smith, W. F., & Hashemi, J. (2014). *Foundations of materials science*. McGraw-Hill.
3. Shackelford, J. F. (2015). *Introduction to materials science for engineers*. Pearson.
4. Askeland, D. R., & Phulé, P. P. (2016). *The science and engineering of materials*. Cengage.
5. Budinski, K. G., & Budinski, M. K. (2015). *Engineering materials*. Pearson.

Reference Books

1. Van Vlack, L. H. (2014). *Elements of materials science*. Addison-Wesley.
2. Ashby, M. F. (2017). *Materials selection in mechanical design*. Butterworth-Heinemann.
3. Dieter, G. E. (2013). *Mechanical metallurgy*. McGraw-Hill.
4. Jones, R. M. (2015). *Mechanics of composite materials*. Taylor & Francis.
5. Hull, D., & Clyne, T. W. (2019). *An introduction to composite materials*. Cambridge.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Design Thinking & Innovation

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand design thinking methodology
2. Develop creative problem solving skills
3. Apply innovation processes to engineering
4. Encourage user centered design approach
5. Promote entrepreneurial mindset

Course Outcomes

- CO1: Apply design thinking stages
- CO2: Generate innovative solutions
- CO3: Develop prototypes and concepts
- CO4: Evaluate solutions critically
- CO5: Demonstrate teamwork and creativity

Detailed Syllabus

Unit I
Design thinking fundamentals; problem identification; empathy mapping; user needs analysis; innovation context.

Unit II
Ideation techniques; brainstorming; creative thinking tools; concept generation; evaluation methods.

Unit III
Prototyping basics; low fidelity models; testing methods; feedback incorporation; iterative improvement.

Unit IV
Innovation management; design strategy; intellectual property basics; engineering entrepreneurship.

Unit V
Case studies; design projects; interdisciplinary collaboration; real world engineering challenges.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.
2. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown.
3. Liedtka, J., & Ogilvie, T. (2015). *Designing for growth*. Columbia University Press.
4. Ulrich, K. T., & Eppinger, S. D. (2016). *Product design and development*. McGraw-Hill.
5. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.

Reference Books

1. Cross, N. (2011). *Design thinking*. Berg.
2. Verganti, R. (2016). *Overcrowded*. MIT Press.
3. IDEO. (2015). *The field guide to human centered design*. IDEO.org.

4. Blank, S. (2013). *The startup owner's manual*. K&S Ranch.
5. Tidd, J., & Bessant, J. (2018). *Managing innovation*. Wiley.

Evaluation Scheme
Continuous Assessment (100%)

Internship / Industrial Orientation

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industrial environments
2. Understand workplace practices and safety
3. Observe engineering operations
4. Relate theory to practice
5. Develop professional discipline

Course Outcomes

- CO1: Identify industrial processes
- CO2: Follow safety and ethical practices
- CO3: Observe engineering workflows
- CO4: Relate academic learning to industry
- CO5: Prepare basic industrial reports

Guidelines
Industry visits, orientation programs, supervised training, documentation of observations, submission of internship report.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER III

Signals & Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand representation of signals and systems
2. Analyze continuous and discrete time signals
3. Apply system properties for engineering analysis
4. Study transform methods for signal analysis
5. Build foundation for control and communication systems

Course Outcomes

- CO1: Classify and represent signals
- CO2: Analyze properties of systems
- CO3: Apply convolution techniques
- CO4: Use Fourier and Laplace transforms
- CO5: Interpret system behavior in time and frequency domains

Detailed Syllabus

Unit I
Signal classification, continuous and discrete signals; deterministic and random signals; periodic and aperiodic signals; energy and power signals; basic signal operations, time shifting, scaling, reversal; engineering signal representation fundamentals.

Unit II
System classification; linear and nonlinear systems; time invariant and time variant systems; causal and non causal systems; stable and unstable systems; interconnection of systems; engineering interpretation of system properties.

Unit III
Continuous time convolution; graphical and analytical methods; properties of convolution; discrete time convolution summation; impulse response; step response; engineering applications in signal processing and system analysis.

Unit IV
Fourier series representation; trigonometric and exponential forms; symmetry properties;

Fourier transform; properties; frequency domain interpretation; magnitude and phase spectra; engineering relevance in communication and robotics.

Unit V
Laplace transform; region of convergence; properties; inverse Laplace transform; system transfer function; poles and zeros; stability interpretation; time domain response analysis of engineering systems.

Text Books

1. Oppenheim, A. V., Willsky, A. S., & Nawab, S. H. (2015). *Signals and systems* (2nd ed.). Pearson.
2. Lathi, B. P. (2017). *Linear systems and signals*. Oxford University Press.
3. Haykin, S., & Van Veen, B. (2014). *Signals and systems*. Wiley.
4. Proakis, J. G., & Manolakis, D. G. (2016). *Digital signal processing*. Pearson.
5. Carlson, A. B. (2018). *Communication systems*. McGraw-Hill.

Reference Books

1. Roberts, M. J. (2016). *Signals and systems*. McGraw-Hill.
2. Phillips, C. L., Parr, J. M., & Riskin, E. A. (2015). *Signals, systems, and transforms*. Pearson.
3. Venkataramani, R., & Bhaskar, T. (2018). *Signals and systems*. McGraw-Hill India.
4. Boylestad, R. (2017). *Introductory circuit analysis*. Pearson.
5. Orfanidis, S. J. (2016). *Introduction to signal processing*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Sensors, Transducers & Instrumentation

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand sensor and transducer principles
2. Study measurement systems and characteristics
3. Analyze signal conditioning techniques
4. Apply sensors in robotics applications
5. Develop instrumentation fundamentals

Course Outcomes

- CO1: Classify sensors and transducers
- CO2: Explain operating principles of sensors
- CO3: Analyze static and dynamic characteristics
- CO4: Apply signal conditioning methods
- CO5: Select sensors for robotics systems

Detailed Syllabus

Unit I
Measurement systems; classification; accuracy, precision, sensitivity; static characteristics; errors and calibration; standards; engineering relevance of measurement quality and reliability.

Unit II
Displacement sensors; potentiometric, LVDT, capacitive sensors; force and torque sensors; strain gauges; applications in robotic systems and mechanical measurements.

Unit III
Temperature sensors; thermocouples, RTD, thermistors; pressure sensors; piezoelectric sensors; response characteristics; industrial and robotic measurement applications.

Unit IV
Optical sensors; photoelectric devices; encoders; proximity sensors; ultrasonic sensors; non contact measurement techniques; automation and robotics relevance.

Unit V
Signal conditioning; amplifiers; filters; ADC and DAC basics; noise reduction; data acquisition systems; interfacing sensors with control and embedded platforms.

Text Books

1. Doebelin, E. O., & Manik, D. N. (2016). *Measurement systems*. McGraw-Hill.
2. Fraden, J. (2016). *Handbook of modern sensors* (5th ed.). Springer.
3. Patranabis, D. (2014). *Sensors and transducers*. PHI Learning.
4. Bentley, J. P. (2015). *Principles of measurement systems*. Pearson.
5. Bolton, W. (2015). *Instrumentation and control systems*. Elsevier.

Reference Books

1. Webster, J. G. (2014). *Measurement, instrumentation, and sensors handbook*. CRC Press.

2. Ramon Pallas-Areny, & Webster, J. G. (2012). *Sensors and signal conditioning*. Wiley.
3. Morris, A. S., & Langari, R. (2016). *Measurement and instrumentation*. Academic Press.
4. Northrop, R. B. (2014). *Introduction to instrumentation and measurements*. CRC Press.
5. Turner, J. D. (2017). *Instrumentation sensors and transducers*. PHI Learning.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Analog Electronics

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand analog semiconductor devices
2. Analyze amplifier circuits
3. Study frequency response characteristics
4. Apply operational amplifiers
5. Build foundation for electronic system design

Course Outcomes

- CO1: Explain diode and transistor operation
- CO2: Analyze BJT and MOSFET amplifiers
- CO3: Interpret frequency response
- CO4: Apply operational amplifier circuits
- CO5: Design basic analog circuits

Detailed Syllabus

Unit I
PN junction diode characteristics; rectifiers; Zener diode regulation; clipping and clamping circuits; power supply fundamentals; engineering relevance of diode applications.

Unit II
BJT operation; configurations; CE, CB, CC amplifiers; biasing techniques; small signal analysis; gain and impedance considerations in analog circuits.

Unit III
MOSFET operation; characteristics; common source, common drain amplifiers; biasing; frequency response; applications in modern electronic systems.

Unit IV
Operational amplifiers; ideal characteristics; practical limitations; linear applications; amplifiers, integrators, differentiators; signal conditioning relevance.

Unit V
Oscillators; feedback principles; RC, LC oscillators; power amplifiers; efficiency; distortion; analog signal generation and processing applications.

Text Books

1. Boylestad, R. L., & Nashelsky, L. (2015). *Electronic devices and circuit theory*. Pearson.
2. Sedra, A. S., & Smith, K. C. (2016). *Microelectronic circuits*. Oxford University Press.
3. Malvino, A. P., & Bates, D. J. (2015). *Electronic principles*. McGraw-Hill.
4. Floyd, T. L. (2017). *Electronic devices*. Pearson.
5. Millman, J., & Halkias, C. C. (2014). *Integrated electronics*. McGraw-Hill.

Reference Books

1. Neamen, D. A. (2018). *Microelectronics circuit analysis and design*. McGraw-Hill.
2. Gray, P. R., & Meyer, R. G. (2015). *Analysis and design of analog integrated circuits*. Wiley.
3. Razavi, B. (2017). *Fundamentals of microelectronics*. Wiley.
4. Ghausi, M. S., & Kelly, J. J. (2016). *Introduction to distributed parameter networks*. Holt.
5. Franco, S. (2014). *Design with operational amplifiers*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Microprocessors & Microcontrollers

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand microprocessor architecture

2. Study instruction sets and programming
3. Learn microcontroller architecture
4. Interface peripherals and memory
5. Apply controllers in robotics systems

Course Outcomes

- CO1: Explain microprocessor architecture
- CO2: Develop assembly level programs
- CO3: Understand microcontroller features
- CO4: Interface peripherals
- CO5: Apply controllers in automation

Detailed Syllabus

Unit I
Microprocessor concepts; architecture; bus systems; registers; instruction cycle; memory organization; engineering relevance of programmable systems.

Unit II
Instruction sets; addressing modes; assembly language programming; data transfer, arithmetic, logic operations; program control techniques.

Unit III
Microcontroller architecture; internal organization; timers; interrupts; serial communication; embedded system fundamentals.

Unit IV
Interfacing memory; I O devices; ADC, DAC; keyboard, display interfacing; engineering system integration.

Unit V
Applications in robotics; motor control basics; sensor interfacing; real time control considerations; embedded application development.

Text Books

1. Gaonkar, R. S. (2014). *Microprocessor architecture, programming, and applications*. Wiley.
2. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. (2018). *The 8051 microcontroller*. Pearson.
3. Brey, B. B. (2013). *The Intel microprocessors*. Pearson.
4. Ayala, K. J. (2014). *The 8051 microcontroller*. Cengage Learning.

5. Valvano, J. (2017). *Embedded systems*. Cengage Learning.

Reference Books

1. Krishna Kant. (2016). *Microprocessors and microcontrollers*. PHI Learning.
2. Raj Kamal. (2015). *Embedded systems*. McGraw-Hill.
3. Peatman, J. B. (2014). *Design with microcontrollers*. McGraw-Hill.
4. Barrett, S., & Pack, D. (2016). *Embedded systems design*. Pearson.
5. Heath, S. (2017). *Embedded systems design*. Newnes.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Actuators & Drive Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand actuator principles
2. Study electrical and mechanical drives
3. Analyze motor characteristics
4. Apply drives in robotic systems
5. Select actuators for applications

Course Outcomes

- CO1: Classify actuators
- CO2: Explain motor operating principles
- CO3: Analyze drive characteristics
- CO4: Apply actuators in robotics
- CO5: Select appropriate drive systems

Detailed Syllabus

Unit I
Actuator fundamentals; classification; electrical, hydraulic, pneumatic actuators; performance parameters; engineering relevance in automation systems.

Unit II
DC motors; construction; characteristics; speed control; torque speed relationships; applications in robotic motion systems.

Unit III
AC motors; induction motors; synchronous motors; characteristics; control basics; industrial drive applications.

Unit IV
Stepper motors; servo motors; construction; control principles; positioning accuracy; robotics and automation relevance.

Unit V
Drive systems; power electronics interface; motor drivers; protection; efficiency considerations; integrated actuator drive selection.

Text Books

1. Hughes, A., & Drury, B. (2019). *Electric motors and drives*. Elsevier.
2. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2014). *Electric machinery*. McGraw-Hill.
3. Sen, P. C. (2013). *Principles of electric machines and power electronics*. Wiley.
4. Krishnan, R. (2017). *Electric motor drives*. Pearson.
5. Chapman, S. J. (2015). *Electric machinery fundamentals*. McGraw-Hill.

Reference Books

1. Bose, B. K. (2014). *Modern power electronics and AC drives*. Prentice Hall.
2. Dubey, G. K. (2016). *Power semiconductor controlled drives*. PHI.
3. Pillai, S. K. (2015). *A first course on electrical drives*. Wiley.
4. Leonhard, W. (2017). *Control of electrical drives*. Springer.
5. Boldea, I., & Nasar, S. A. (2016). *Electric drives*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Humanities Elective (Ethics / Indian Constitution)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand ethical principles

2. Study constitutional values
3. Develop professional responsibility
4. Promote social awareness
5. Build value based engineering outlook

Course Outcomes

- CO1: Apply ethical reasoning
- CO2: Understand constitutional provisions
- CO3: Relate ethics to engineering practice
- CO4: Demonstrate social responsibility
- CO5: Follow professional conduct

Guidelines
Ethics theories; professional ethics; Indian Constitution features; fundamental rights and duties; role of engineers in society.

Evaluation Scheme
Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Gain practical industrial exposure
2. Observe engineering practices
3. Understand workplace discipline
4. Relate theory to real applications
5. Develop professional skills

Course Outcomes

- CO1: Identify industrial systems
- CO2: Observe safety practices
- CO3: Apply academic knowledge
- CO4: Document industrial learning

- CO5: Demonstrate professional behavior

Guidelines
Supervised industrial training, observation reports, technical documentation, evaluation by internal committee.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IV

Course 1: Control Systems Engineering

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamentals of control systems
2. Analyze mathematical models of dynamic systems
3. Study time and frequency domain techniques
4. Evaluate system stability and performance
5. Apply control concepts to robotics and automation

Course Outcomes

- CO1: Model physical systems using transfer functions
- CO2: Analyze time domain response characteristics
- CO3: Evaluate stability using classical techniques
- CO4: Apply frequency domain methods
- CO5: Interpret control system performance measures

Detailed Syllabus

Unit I
Control system concepts, open loop and closed loop systems; feedback principles; classification of control systems; block diagram representation; signal flow graphs; modeling of mechanical and electrical systems for control analysis.

Unit II
Transfer functions; time response analysis; step, impulse, ramp responses; transient and steady state specifications; error coefficients; performance indices; engineering interpretation of dynamic system behavior.

Unit III
Stability concepts; Routh Hurwitz criterion; relative stability; root locus technique; construction rules; effect of pole zero locations; controller influence on system stability and response.

Unit IV
Frequency response analysis; Bode plots; polar plots; Nyquist criterion; gain margin and phase margin; robustness interpretation; control system bandwidth considerations.

Unit V
Controllers and compensators; P, PI, PD control actions; lead, lag, lead lag compensation; introduction to state space concepts; control applications in robotics and automation systems.

Text Books

1. Ogata, K. (2015). *Modern control engineering* (5th ed.). Pearson.
2. Nagrath, I. J., & Gopal, M. (2017). *Control systems engineering*. New Age International.
3. Dorf, R. C., & Bishop, R. H. (2017). *Modern control systems*. Pearson.
4. Kuo, B. C. (2014). *Automatic control systems*. Wiley.
5. Norman, S. N. (2016). *Control systems*. Wiley India.

Reference Books

1. Franklin, G. F., Powell, J. D., & Emami-Naeini, A. (2015). *Feedback control of dynamic systems*. Pearson.
2. Astrom, K. J., & Murray, R. M. (2016). *Feedback systems*. Princeton University Press.
3. Phillips, C. L., & Harbor, R. D. (2014). *Feedback control systems*. Pearson.
4. Skogestad, S., & Postlethwaite, I. (2016). *Multivariable feedback control*. Wiley.
5. Chen, C. T. (2013). *Linear system theory and design*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Robotics Engineering Fundamentals

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand basic concepts of robotics
2. Study robot configurations and components
3. Analyze robot kinematics
4. Introduce robot control concepts
5. Apply robotics fundamentals to applications

Course Outcomes

- CO1: Identify robot types and configurations
- CO2: Analyze forward and inverse kinematics
- CO3: Understand robot workspace and motion
- CO4: Explain basic robot control methods
- CO5: Relate robotics concepts to applications

Detailed Syllabus

Unit I
Introduction to robotics; robot definition; classification; robot anatomy; degrees of freedom; coordinate systems; industrial and service robot applications overview.

Unit II
Robot kinematics; link parameters; Denavit Hartenberg representation; homogeneous transformation matrices; forward kinematics formulation for serial manipulators.

Unit III
Inverse kinematics concepts; solution methods; multiple solutions; singularities; workspace analysis; joint space and Cartesian space relationships.

Unit IV
Differential kinematics; Jacobian matrix; velocity and acceleration analysis; static forces and torques; relevance to robot motion control.

Unit V
Introduction to robot control; point to point control; continuous path control; basic sensors and actuators in robots; overview of robotic applications.

Text Books

1. Craig, J. J. (2018). *Introduction to robotics: Mechanics and control*. Pearson.
2. Groover, M. P. (2016). *Industrial robotics*. McGraw-Hill.
3. Fu, K. S., Gonzalez, R. C., & Lee, C. S. G. (2014). *Robotics: Control, sensing, vision, and intelligence*. McGraw-Hill.
4. Asada, H., & Slotine, J. J. (2015). *Robot analysis and control*. Wiley.
5. Klafter, R. D., Chmielewski, T. A., & Negin, M. (2014). *Robotic engineering*. Prentice Hall.

Reference Books

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2017). *Robot modeling and control*. Wiley.
2. Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2016). *Robotics: Modelling, planning and control*. Springer.

3. Schilling, R. J. (2015). *Fundamentals of robotics*. Prentice Hall.
4. Corke, P. (2017). *Robotics, vision and control*. Springer.
5. Lynch, K. M., & Park, F. C. (2017). *Modern robotics*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Embedded Systems Design

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand embedded system architecture
2. Study hardware and software co design
3. Learn interfacing techniques
4. Apply real time concepts
5. Develop embedded applications

Course Outcomes

- CO1: Explain embedded system components
- CO2: Develop simple embedded programs
- CO3: Interface peripherals and sensors
- CO4: Understand real time constraints
- CO5: Apply embedded systems in robotics

Detailed Syllabus

Unit I
Embedded system overview; architecture; hardware software components; embedded processors; memory organization; development tools and workflow.

Unit II
Embedded programming concepts; C for embedded systems; interrupts; timers; polling and interrupt driven systems; program structure.

Unit III
Peripheral interfacing; GPIO; timers; ADC, DAC; serial communication interfaces; sensor and actuator interfacing techniques.

Unit IV
Real time systems; scheduling concepts; task management; latency; performance constraints; reliability considerations in embedded applications.

Unit V
Embedded system applications; robotics controllers; automation systems; case studies; design considerations for industrial embedded solutions.

Text Books

1. Raj Kamal. (2015). *Embedded systems*. McGraw-Hill.
2. Valvano, J. (2017). *Embedded systems*. Cengage Learning.
3. Simon, D. (2014). *An embedded software primer*. Addison-Wesley.
4. Barr, M., & Massa, A. (2014). *Programming embedded systems*. O'Reilly Media.
5. Heath, S. (2017). *Embedded systems design*. Newnes.

Reference Books

1. Wolf, W. (2015). *Computers as components*. Morgan Kaufmann.
2. Ganssle, J. (2016). *The art of designing embedded systems*. Newnes.
3. Labrosse, J. J. (2014). *Embedded real time operating systems*. CMP Books.
4. Noergaard, T. (2018). *Embedded systems architecture*. Newnes.
5. Vahid, F., & Givargis, T. (2017). *Embedded system design*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Mechatronics Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand integrated mechanical and electronic systems
2. Study sensors actuators and controllers
3. Analyze mechatronic system design
4. Apply modeling techniques
5. Develop multidisciplinary engineering approach

Course Outcomes

- CO1: Explain mechatronics system elements
- CO2: Integrate sensors actuators and controllers
- CO3: Analyze system models
- CO4: Apply control strategies
- CO5: Design basic mechatronic systems

Detailed Syllabus

Unit I
Introduction to mechatronics; system components; sensors, actuators, controllers; interdisciplinary nature; applications in automation and robotics.

Unit II
Mechanical systems modeling; electrical analogies; dynamic modeling; system representation; relevance in mechatronic design.

Unit III
Sensors and actuators integration; signal conditioning; interfacing techniques; data acquisition; practical mechatronic system implementation.

Unit IV
Control of mechatronic systems; open loop and closed loop control; PID controllers; performance considerations; stability aspects.

Unit V
Industrial mechatronic applications; CNC machines; automated manufacturing; robotics case studies; system level design considerations.

Text Books

1. Bolton, W. (2015). *Mechatronics*. Pearson.
2. Alciatore, D. G., & Histand, M. B. (2018). *Introduction to mechatronics and measurement systems*. McGraw-Hill.
3. Bishop, R. H. (2014). *Mechatronic systems, sensors, and actuators*. CRC Press.
4. Shetty, D., & Kolk, R. (2016). *Mechatronics system design*. Cengage Learning.
5. Devdas Shetty. (2015). *Mechatronics*. Cengage Learning.

Reference Books

1. Bradley, D. A., Dawson, D., Burd, N., & Loader, A. (2016). *Mechatronics*. CRC Press.
2. Fraser, S., & Milne, J. (2015). *Electromechanical engineering*. CRC Press.
3. Raghuwanshi, N. K. (2014). *Mechatronics and microprocessors*. PHI Learning.

4. Jazar, R. (2017). *Theory of applied robotics*. Springer.
5. Tomovic, R. (2016). *General sensitivity theory*. Elsevier.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (AI / IoT / Data Analytics)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce emerging interdisciplinary technologies
2. Develop awareness of AI IoT and analytics
3. Apply elective concepts to engineering problems
4. Encourage self learning and exploration
5. Build adaptability to technology trends

Course Outcomes

- CO1: Explain fundamentals of chosen elective
- CO2: Apply concepts to simple applications
- CO3: Analyze interdisciplinary relevance
- CO4: Evaluate technology impact
- CO5: Demonstrate independent learning ability

Detailed Syllabus

Unit I
Overview of artificial intelligence, IoT, data analytics; scope and applications; relevance to robotics and automation.

Unit II
Fundamental concepts of selected elective area; basic models, architectures, or frameworks; engineering problem context.

Unit III
Tools and technologies overview; platforms, software environments; data handling or sensing basics.

Unit IV
Application case studies; industry use cases; integration with robotic systems.

Unit V
Future trends; challenges; ethical and societal considerations; interdisciplinary impact analysis.

Text Books

1. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach*. Pearson.
2. McKinney, W. (2018). *Python for data analysis*. O'Reilly Media.
3. Bahga, A., & Madisetti, V. (2014). *Internet of things*. VPT.
4. Provost, F., & Fawcett, T. (2013). *Data science for business*. O'Reilly Media.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Reference Books

1. Aggarwal, C. C. (2018). *Machine learning for data science*. Springer.
2. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). *Internet of things vision*. Elsevier.
3. Bishop, C. M. (2016). *Pattern recognition and machine learning*. Springer.
4. Han, J., Kamber, M., & Pei, J. (2014). *Data mining*. Morgan Kaufmann.
5. Zikopoulos, P., & Eaton, C. (2012). *Understanding big data*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Robotronics Laboratory

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop practical skills in robotronics systems
2. Integrate sensors actuators and controllers
3. Implement basic robotic experiments
4. Strengthen troubleshooting skills
5. Reinforce theoretical concepts through practice

Course Outcomes

- CO1: Assemble basic robotic systems
- CO2: Interface sensors and actuators

- CO3: Program embedded controllers
- CO4: Analyze experimental results
- CO5: Demonstrate safe laboratory practices

List of Experiments / Exercises

1. Study of robot controller hardware, identification of functional blocks, power supply requirements, and safety precautions for laboratory robotic systems.
2. Interfacing of basic sensors with microcontroller platforms, signal acquisition methods, calibration techniques, and interpretation of sensor data.
3. Control of DC motor using motor driver circuits, speed variation techniques, torque observation, and response analysis.
4. Stepper motor control experiment, step angle calculation, direction control, and positioning accuracy assessment.
5. Servo motor interfacing, pulse width modulation control, angular positioning, and response behavior analysis.
6. Implementation of line follower robot logic using sensors, decision algorithms, and actuator control.
7. Obstacle detection and avoidance experiment using proximity sensors, logic development, and motion control.
8. Encoder based speed and position measurement, signal processing, and feedback interpretation.
9. Integration of sensors actuators and controller for simple robotic task execution, system testing, and troubleshooting.
10. Mini robotic application demonstration, documentation of design, testing procedures, and performance evaluation.
11. Study of industrial robotic arm components, joint movements, end effector operation, and safety practices.
12. Laboratory project exercise focusing on system integration, debugging methods, and presentation of results.

Expected Outcomes
Enhanced hands on competence in robotronics systems, improved integration skills, better understanding of robotics hardware software interaction, and readiness for advanced robotic applications.

Evaluation Scheme
Continuous Assessment (60%) + End-SEMESTER Practical Examination (40%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Strengthen industry exposure
2. Observe advanced engineering practices
3. Understand organizational workflows
4. Relate academic knowledge to practice
5. Develop professional reporting skills

Course Outcomes

- CO1: Identify industrial automation practices
- CO2: Follow safety and quality norms
- CO3: Apply theoretical concepts in industry
- CO4: Prepare structured internship reports
- CO5: Demonstrate professional ethics

Guidelines
Supervised industrial training, technical observation, documentation, presentation, internal evaluation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER V

Course 1: Industrial Robotics & Automation

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand industrial robot configurations and applications
2. Study automation components and architectures
3. Analyze robotic work cells and automation systems
4. Apply robotics in manufacturing environments
5. Develop competence in industrial automation concepts

Course Outcomes

- CO1: Identify industrial robot types and applications
- CO2: Analyze robotic work cell configurations
- CO3: Understand automation hardware and software
- CO4: Apply industrial robotics principles
- CO5: Evaluate automation system performance

Detailed Syllabus

Unit I
Industrial robotics overview; history, classification; robot anatomy; degrees of freedom; payload, reach, repeatability; industrial robot specifications; selection criteria; manufacturing automation relevance.

Unit II
Robot drives and transmission systems; electric, hydraulic, pneumatic drives; end effectors; grippers and tools; tooling considerations; industrial handling and assembly applications.

Unit III
Robot programming concepts; teach pendant programming; online and offline programming; motion commands; path planning basics; industrial robot programming environments.

Unit IV
Automation systems; PLC fundamentals; sensors and actuators integration; industrial communication protocols; safety standards; robotic cell control architecture.

Unit V
Industrial applications; welding, painting, assembly, material handling; flexible

manufacturing systems; robotic automation case studies; productivity and quality considerations.

Text Books

1. Groover, M. P. (2016). *Automation, production systems, and computer-integrated manufacturing*. Pearson.
2. Groover, M. P. (2016). *Industrial robotics*. McGraw-Hill.
3. Craig, J. J. (2018). *Introduction to robotics: Mechanics and control*. Pearson.
4. Niku, S. B. (2019). *Introduction to robotics*. Wiley.
5. Majumdar, R. (2015). *Industrial robotics*. McGraw-Hill.

Reference Books

1. Schilling, R. J. (2015). *Fundamentals of robotics*. Prentice Hall.
2. Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2016). *Robotics: Modelling, planning and control*. Springer.
3. Monkman, G. J. (2013). *Robot grippers*. Wiley.
4. Bolton, W. (2015). *Programmable logic controllers*. Elsevier.
5. Kelmar, L. (2014). *Industrial automation*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Mobile Robotics & Autonomous Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand mobile robot architectures
2. Study locomotion and navigation methods
3. Analyze perception and localization techniques
4. Introduce autonomous decision making
5. Apply mobile robotics concepts

Course Outcomes

- CO1: Classify mobile robot types
- CO2: Analyze locomotion mechanisms

- CO3: Understand navigation and localization
- CO4: Apply perception techniques
- CO5: Explain autonomous system behavior

Detailed Syllabus

Unit I
Mobile robotics introduction; wheeled, legged, tracked robots; kinematic constraints; mobility analysis; applications in service and field robotics.

Unit II
Locomotion mechanisms; differential drive; steering methods; motion control; odometry; practical mobility considerations.

Unit III
Localization techniques; dead reckoning; sensor based localization; map representation; uncertainty handling; engineering relevance.

Unit IV
Navigation and path planning; obstacle avoidance; global and local planning; reactive and deliberative control strategies.

Unit V
Autonomous systems; perception sensors; decision making basics; multi sensor integration; applications in autonomous robots.

Text Books

1. Siegwart, R., Nourbakhsh, I. R., & Scaramuzza, D. (2018). *Introduction to autonomous mobile robots*. MIT Press.
2. Thrun, S., Burgard, W., & Fox, D. (2015). *Probabilistic robotics*. MIT Press.
3. Dudek, G., & Jenkin, M. (2010). *Computational principles of mobile robotics*. Cambridge.
4. LaValle, S. M. (2006). *Planning algorithms*. Cambridge University Press.
5. Corke, P. (2017). *Robotics, vision and control*. Springer.

Reference Books

1. Arkin, R. C. (2013). *Behavior-based robotics*. MIT Press.
2. Borenstein, J., Everett, H. R., & Feng, L. (2014). *Where am I? Sensors and methods*. University of Michigan.
3. Gonzalez, R. C., & Woods, R. E. (2018). *Digital image processing*. Pearson.
4. Murphy, R. R. (2019). *Introduction to AI robotics*. MIT Press.

5. Khatib, O. (2016). *Robotics foundations*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Machine Vision & Image Processing

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fundamentals of digital image processing
2. Study image acquisition and enhancement
3. Analyze feature extraction techniques
4. Apply vision systems in robotics
5. Develop machine vision application skills

Course Outcomes

- CO1: Explain image representation concepts
- CO2: Apply image enhancement techniques
- CO3: Perform image segmentation
- CO4: Extract and analyze features
- CO5: Apply vision in robotic applications

Detailed Syllabus

Unit I
Digital image fundamentals; image representation; sampling and quantization; image acquisition systems; vision sensors; robotics relevance.

Unit II
Image enhancement techniques; spatial domain methods; filtering; noise reduction; contrast enhancement; practical vision improvement.

Unit III
Image transformation; frequency domain concepts; Fourier transform basics; filtering techniques; engineering applications.

Unit IV
Image segmentation; edge detection; thresholding; region based methods; object extraction; scene understanding.

Unit V
Feature extraction; shape, texture features; pattern recognition basics; machine vision applications in robotics and automation.

Text Books

1. Gonzalez, R. C., & Woods, R. E. (2018). *Digital image processing*. Pearson.
2. Sonka, M., Hlavac, V., & Boyle, R. (2014). *Image processing, analysis, and machine vision*. Cengage.
3. Jain, A. K. (2016). *Fundamentals of digital image processing*. Pearson.
4. Davies, E. R. (2017). *Computer and machine vision*. Academic Press.
5. Pratt, W. K. (2014). *Digital image processing*. Wiley.

Reference Books

1. Nixon, M., & Aguado, A. (2012). *Feature extraction and image processing*. Academic Press.
2. Bishop, C. M. (2016). *Pattern recognition and machine learning*. Springer.
3. Forsyth, D. A., & Ponce, J. (2012). *Computer vision*. Pearson.
4. Szeliski, R. (2010). *Computer vision: Algorithms and applications*. Springer.
5. Milan Sonka. (2014). *Image processing handbook*. Cengage.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Human–Robot Interaction

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of human robot interaction
2. Study interaction modalities and interfaces
3. Analyze safety and usability aspects
4. Apply HRI concepts to robot design
5. Develop user centered robotics perspective

Course Outcomes

- CO1: Explain HRI fundamentals

- CO2: Identify interaction methods
- CO3: Analyze usability and safety
- CO4: Apply interface design principles
- CO5: Evaluate human robot systems

Detailed Syllabus

Unit I
Introduction to human robot interaction; interaction paradigms; social and physical interaction; multidisciplinary perspectives; application domains.

Unit II
Human factors; cognition; perception; ergonomics; usability principles; user centered design considerations.

Unit III
Interaction modalities; speech, gesture, vision based interaction; multimodal interfaces; communication techniques.

Unit IV
Safety and ethics; physical safety standards; trust; transparency; ethical considerations in HRI systems.

Unit V
Applications of HRI; service robots; healthcare robots; collaborative robots; evaluation metrics and case studies.

Text Books

1. Goodrich, M. A., & Schultz, A. C. (2007). *Human–robot interaction*. Now Publishers.
2. Dautenhahn, K. (2014). *Human robot interaction*. Wiley.
3. Fong, T., Nourbakhsh, I., & Dautenhahn, K. (2013). *A survey of socially interactive robots*. Robotics Institute.
4. Sheridan, T. B. (2016). *Human–robot interaction*. MIT Press.
5. Norman, D. A. (2013). *The design of everyday things*. Basic Books.

Reference Books

1. Salvendy, G. (2012). *Handbook of human factors*. Wiley.
2. Parasuraman, R., & Riley, V. (2014). *Humans and automation*. Human Factors Journal.
3. Siciliano, B., & Khatib, O. (2016). *Springer handbook of robotics*. Springer.
4. Endsley, M. R. (2017). *Situation awareness*. CRC Press.

5. ISO 10218. (2011). *Robots and robotic devices safety requirements*. ISO.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Service Robotics / Medical Robotics)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce specialized robotics applications
2. Understand service or medical robotics systems
3. Analyze design and safety considerations
4. Apply robotics in specialized domains
5. Develop awareness of emerging applications

Course Outcomes

- CO1: Explain elective domain fundamentals
- CO2: Analyze system architectures
- CO3: Understand safety and standards
- CO4: Apply robotics to real world problems
- CO5: Evaluate societal impact

Detailed Syllabus

Unit I
Overview of service and medical robotics; application domains; system requirements; challenges; opportunities.

Unit II
Service robotics systems; domestic, logistics, hospitality robots; functional components; interaction aspects.

Unit III
Medical robotics systems; surgical robots; rehabilitation robots; assistive devices; clinical requirements.

Unit IV
Safety, standards, and regulations; reliability; human interaction; ethical considerations; compliance aspects.

Unit V
Future trends; research directions; commercialization; interdisciplinary integration; case studies.

Text Books

1. Siciliano, B., & Khatib, O. (2016). *Springer handbook of robotics*. Springer.
2. Taylor, R. H., Menciassi, A., Fichtinger, G., & Fiorini, P. (2016). *Medical robotics*. Springer.
3. van der Loos, M. (2015). *Service robotics*. Wiley.
4. Murphy, R. R. (2019). *Introduction to AI robotics*. MIT Press.
5. Webster, J. G. (2015). *Medical instrumentation*. Wiley.

Reference Books

1. Rosen, J., Hannaford, B., & Satava, R. M. (2011). *Surgical robotics*. Springer.
2. Dautenhahn, K. (2014). *Socially intelligent robots*. Springer.
3. ISO 13482. (2014). *Safety requirements for personal care robots*. ISO.
4. Hockstein, N. G. (2007). *Robotic surgery*. Springer.
5. Bekey, G. A. (2012). *Autonomous robots*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project (Robotic System Design)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply robotics knowledge to system design
2. Develop problem solving and design skills
3. Integrate hardware and software components
4. Practice project documentation
5. Enhance teamwork and presentation skills

Course Outcomes

- CO1: Identify problem statements
- CO2: Design robotic system solutions

- CO3: Implement and test prototypes
- CO4: Document project work
- CO5: Present and defend project outcomes

Guidelines
Problem identification; literature survey; system design; implementation; testing; documentation; internal review; project demonstration.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VI

Course 1: Artificial Intelligence for Robotics

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand artificial intelligence concepts for robotics
2. Study knowledge representation and reasoning techniques
3. Analyze search and planning methods
4. Apply machine learning basics in robotics
5. Integrate AI techniques with robotic systems

Course Outcomes

- CO1: Explain artificial intelligence fundamentals
- CO2: Apply search and reasoning techniques
- CO3: Analyze planning and decision making methods
- CO4: Apply learning algorithms in robotics
- CO5: Integrate AI concepts in autonomous robots

Detailed Syllabus

Unit I
Artificial intelligence overview; intelligent agents; problem formulation; state space representation; uninformed and informed search strategies; heuristic concepts; engineering relevance in robotics autonomy.

Unit II
Knowledge representation; propositional and predicate logic; inference mechanisms; reasoning methods; expert systems concepts; applicability in robotic decision making systems.

Unit III
Planning techniques; classical planning; state space planning; planning graphs; constraint satisfaction problems; task planning relevance for robotic manipulation and navigation.

Unit IV
Machine learning fundamentals; supervised and unsupervised learning; regression and classification concepts; clustering methods; learning relevance in perception and control systems.

Unit V
AI applications in robotics; perception; localization; navigation; human robot interaction; ethical considerations; integration challenges in real world robotic systems.

Text Books

1. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach*. Pearson.
2. Murphy, R. R. (2019). *Introduction to AI robotics*. MIT Press.
3. Poole, D. L., & Mackworth, A. K. (2017). *Artificial intelligence: Foundations of computational agents*. Cambridge University Press.
4. Nilsson, N. J. (2014). *Principles of artificial intelligence*. Morgan Kaufmann.
5. Luger, G. F. (2018). *Artificial intelligence: Structures and strategies*. Pearson.

Reference Books

1. Bishop, C. M. (2016). *Pattern recognition and machine learning*. Springer.
2. Sutton, R. S., & Barto, A. G. (2018). *Reinforcement learning*. MIT Press.
3. Thrun, S., Burgard, W., & Fox, D. (2015). *Probabilistic robotics*. MIT Press.
4. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
5. Bekey, G. A. (2012). *Autonomous robots*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Industrial Safety, Standards & Reliability

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand industrial safety principles
2. Study engineering standards and regulations
3. Analyze reliability concepts
4. Apply safety practices in industrial environments
5. Promote safety culture and compliance

Course Outcomes

- CO1: Explain industrial safety principles
- CO2: Identify hazards and risk factors

- CO3: Apply engineering standards
- CO4: Analyze reliability and failure concepts
- CO5: Implement safety practices in industry

Detailed Syllabus

Unit I
Industrial safety overview; safety philosophy; accident causation theories; hazard identification; risk assessment techniques; safety management systems.

Unit II
Mechanical and electrical safety; machine guarding; electrical hazards; grounding; protective devices; safe operating procedures.

Unit III
Industrial standards; ISO, BIS, IEC standards; quality and safety standards; regulatory frameworks; compliance requirements.

Unit IV
Reliability engineering concepts; failure modes; reliability models; maintainability; availability; applications in engineering systems.

Unit V
Safety management practices; safety audits; training; emergency preparedness; environmental and occupational health considerations.

Text Books

1. Hughes, P., & Ferrett, E. (2016). *Introduction to health and safety at work*. Routledge.
2. Goetsch, D. L. (2014). *Occupational safety and health*. Pearson.
3. Manuele, F. A. (2014). *Advanced safety management*. Wiley.
4. Smith, D. J. (2017). *Reliability, maintainability and risk*. Elsevier.
5. Kletz, T. (2014). *What went wrong?*. Butterworth-Heinemann.

Reference Books

1. Raghuwanshi, B. S. (2015). *Industrial safety engineering*. Laxmi Publications.
2. Dhillon, B. S. (2014). *Engineering safety*. CRC Press.
3. O'Connor, P. D. T., & Kleyner, A. (2012). *Practical reliability engineering*. Wiley.
4. Vinod Kumar, M. N., & Parameshwaran, R. (2017). *Safety and reliability engineering*. PHI Learning.
5. ISO 45001. (2018). *Occupational health and safety management systems*. ISO.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Emerging Trends in Robotronics

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Identify emerging technologies in robotronics
2. Understand interdisciplinary advancements
3. Analyze future robotics applications
4. Study research and innovation trends
5. Develop technology awareness

Course Outcomes

- CO1: Identify emerging robotronics technologies
- CO2: Explain interdisciplinary integration
- CO3: Analyze future applications
- CO4: Evaluate research trends
- CO5: Demonstrate technology awareness

Detailed Syllabus

Unit I
Advanced robotics trends; collaborative robots; soft robotics; swarm robotics; applications and research directions.

Unit II
AI driven robotics; learning based control; cognitive robotics; autonomous decision systems; research challenges.

Unit III
Robotics in healthcare, agriculture, defense; service robotics expansion; societal impact; deployment challenges.

Unit IV
Advanced sensing and perception; sensor fusion; vision based autonomy; tactile sensing; human centered robotics.

Unit V
Industry 4.0 integration; cyber physical systems; digital twins; smart manufacturing; future outlook of robotronics.

Text Books

1. Siciliano, B., & Khatib, O. (2016). *Springer handbook of robotics*. Springer.
2. Corke, P. (2017). *Robotics, vision and control*. Springer.
3. Bekey, G. A. (2012). *Autonomous robots*. MIT Press.
4. Khatib, O., & Siciliano, B. (2018). *Robotics research*. Springer.
5. Kumar, V. (2014). *Distributed robotic systems*. Springer.

Reference Books

1. Asada, H., & Slotine, J. J. (2015). *Robot analysis and control*. Wiley.
2. Brooks, R. A. (2019). *Cambrian intelligence*. MIT Press.
3. Thrun, S. (2015). *Toward robotic autonomy*. MIT Press.
4. Yang, G. Z. (2018). *Medical robotics*. Elsevier.
5. Villani, L. (2016). *Collaborative robotics*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (Smart Manufacturing / Agricultural Robotics)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce advanced application domains
2. Understand smart manufacturing or agricultural robotics
3. Analyze system architectures
4. Apply automation concepts
5. Explore domain specific challenges

Course Outcomes

- CO1: Explain elective domain fundamentals
- CO2: Analyze system components

- CO3: Apply automation strategies
- CO4: Evaluate domain applications
- CO5: Assess future opportunities

Detailed Syllabus

Unit I
Overview of smart manufacturing and agricultural robotics; scope; system requirements; application drivers.

Unit II
Smart manufacturing systems; cyber physical production systems; automation architectures; industrial IoT integration.

Unit III
Agricultural robotics systems; field robots; sensing and actuation; precision agriculture concepts.

Unit IV
Control and automation strategies; data driven decision making; robotics integration challenges.

Unit V
Case studies; sustainability aspects; economic impact; future trends and opportunities.

Text Books

1. Lee, J., Bagheri, B., & Kao, H. A. (2015). *A cyber physical systems architecture*. Manufacturing Letters.
2. Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M. J. (2017). *Big data in smart farming*. Agricultural Systems.
3. Groover, M. P. (2016). *Automation, production systems*. Pearson.
4. Zhang, Q. (2019). *Agricultural automation*. CRC Press.
5. Kusiak, A. (2018). *Smart manufacturing*. International Journal of Production Research.

Reference Books

1. Hermann, M., Pentek, T., & Otto, B. (2016). *Design principles for Industry 4.0*. IEEE.
2. Blackmore, S. (2013). *Agricultural robotics*. Springer.
3. Qin, J. (2016). *Precision agriculture technology*. Elsevier.
4. Lu, Y. (2017). *Industry 4.0*. Journal of Industrial Information Integration.
5. McFarlane, D. (2014). *Manufacturing automation*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project (Industry / Research Based)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Solve complex engineering problems
2. Apply advanced robotronics knowledge
3. Conduct independent research or development
4. Demonstrate professional documentation
5. Present technical outcomes effectively

Course Outcomes

- CO1: Define complex project problems
- CO2: Design and implement solutions
- CO3: Analyze and validate results
- CO4: Prepare technical documentation
- CO5: Defend project work professionally

Guidelines
Problem definition; literature review; system design; implementation; testing; evaluation; dissertation submission; final presentation.

Evaluation Scheme
Continuous Assessment (100%)

Seminar / Viva-Voce

Course Category: Project Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical presentation skills
2. Analyze recent research topics
3. Improve scholarly communication

4. Enhance critical thinking
5. Prepare for professional practice

Course Outcomes

- CO1: Present technical topics effectively
- CO2: Review and analyze literature
- CO3: Respond to technical questions
- CO4: Demonstrate communication competence
- CO5: Exhibit professional attitude

Guidelines
Topic selection; literature survey; seminar presentation; viva voce examination; evaluation by departmental committee.

Evaluation Scheme
Continuous Assessment (100%)

B.Sc. – Sustainable Technology & Climate Systems

Duration: 3 Years | 6 Semesters | Total Credits: 120

SEMESTER I

Course 1

Course Title: Mathematics I (Calculus & Linear Algebra)
Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical foundations required for environmental and sustainability analysis
2. Apply differential and integral calculus to physical and engineering systems
3. Understand vector spaces and linear transformations
4. Solve systems of linear equations using matrix methods
5. Build analytical skills for modeling real world sustainability problems

Course Outcomes
CO1 Apply limits and continuity concepts to scientific problems
CO2 Use differentiation techniques for optimization and rate analysis
CO3 Apply integration methods in area and volume computations
CO4 Solve linear systems using matrices and determinants
CO5 Utilize eigenvalues and eigenvectors in applied contexts

Detailed Syllabus

Unit I: Functions, limits, continuity; algebraic, trigonometric, exponential functions; limit evaluation techniques, continuity conditions, piecewise functions; applications to environmental data trends, mathematical modeling foundations, graphical interpretation, analytical reasoning, quantitative problem solving, engineering relevance.

Unit II: Differentiation techniques; implicit differentiation, higher order derivatives; applications to maxima and minima, curvature, rate of change; optimization in resource management, environmental processes, sensitivity analysis, applied mathematical modeling, engineering system interpretation.

Unit III: Integration methods; definite and indefinite integrals; substitution, integration by parts, partial fractions; applications to area, volume, work; cumulative environmental quantities, mass balance calculations, applied sustainability computations.

Unit IV: Matrices and determinants; matrix operations, rank, inverse; solution of linear equations using Gauss elimination; applications in energy balance models, network analysis, environmental system modeling, computational techniques.

Unit V: Vector spaces; linear independence, basis, dimension; eigenvalues and eigenvectors; diagonalization; applications in stability analysis, climate system modeling, data transformation, applied linear algebra for sustainability studies.

Text Books

1. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' calculus* (14th ed.). Pearson Education.
2. Stewart, J. (2016). *Calculus: Early transcendentals* (8th ed.). Cengage Learning.
3. Anton, H., Bivens, I., & Davis, S. (2014). *Calculus* (10th ed.). Wiley.
4. Strang, G. (2016). *Introduction to linear algebra* (5th ed.). Wellesley Cambridge Press.
5. Lay, D. C., Lay, S. R., & McDonald, J. J. (2018). *Linear algebra and its applications* (5th ed.). Pearson.

Reference Books

1. Kreyszig, E. (2011). *Advanced engineering mathematics* (10th ed.). Wiley.
2. Zill, D. G., & Wright, W. S. (2017). *Advanced engineering mathematics* (6th ed.). Jones & Bartlett.
3. Poole, D. (2014). *Linear algebra: A modern introduction* (4th ed.). Cengage Learning.
4. Hoffman, K., & Kunze, R. (2014). *Linear algebra* (2nd ed.). Pearson.
5. Boylestad, R. (2015). *Introductory circuit analysis* (13th ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Environmental Physics & Earth Systems
Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand physical principles governing Earth systems
2. Analyze energy flows within atmosphere and lithosphere
3. Study climate related physical processes
4. Apply physics concepts to environmental phenomena

5. Build systems level understanding of Earth processes

Course Outcomes
CO1 Explain Earth structure and geophysical processes
CO2 Analyze atmospheric energy balance
CO3 Apply thermodynamics to climate systems
CO4 Understand radiation and heat transfer mechanisms
CO5 Relate physical laws to environmental observations

Detailed Syllabus

Unit I: Earth structure, lithosphere, hydrosphere, atmosphere; physical properties of Earth materials; plate tectonics, seismic waves; geophysical methods, gravitational and magnetic fields, Earth system interactions, environmental relevance, quantitative analysis.

Unit II: Atmospheric composition and structure; pressure, temperature, density variations; atmospheric circulation, Coriolis force; weather systems, climate dynamics, physical modeling, energy transport mechanisms, large scale environmental processes.

Unit III: Solar radiation; electromagnetic spectrum; absorption, reflection, scattering; greenhouse effect, albedo; radiative forcing, climate sensitivity, physical basis of global warming, energy balance analysis.

Unit IV: Thermodynamics of Earth systems; laws of thermodynamics; heat transfer processes; conduction, convection, radiation; phase changes, atmospheric stability, lapse rates, environmental heat exchange processes.

Unit V: Hydrological physics; evaporation, condensation, precipitation; energy and mass balance; ocean circulation basics; physical drivers of climate variability, Earth system feedbacks, applied environmental physics.

Text Books

1. Wallace, J. M., & Hobbs, P. V. (2006). *Atmospheric science: An introductory survey* (2nd ed.). Academic Press.
2. Lutgens, F. K., Tarbuck, E. J., & Tasa, D. (2017). *The atmosphere: An introduction to meteorology* (13th ed.). Pearson.
3. Kump, L. R., Kasting, J. F., & Crane, R. G. (2010). *The Earth system* (3rd ed.). Pearson.
4. Bohren, C. F., & Albrecht, B. A. (1998). *Atmospheric thermodynamics*. Oxford University Press.
5. Hartmann, D. L. (2016). *Global physical climatology* (2nd ed.). Elsevier.

Reference Books

1. Peixoto, J. P., & Oort, A. H. (1992). *Physics of climate*. American Institute of Physics.

2. Andrews, D. G. (2010). *An introduction to atmospheric physics* (2nd ed.). Cambridge University Press.
3. Salby, M. L. (2012). *Physics of the atmosphere and climate*. Cambridge University Press.
4. Wallace, J. M. (2015). *Atmospheric science*. Elsevier.
5. Ruddiman, W. F. (2013). *Earth's climate: Past and future* (3rd ed.). W. H. Freeman.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Environmental Chemistry
Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand chemical principles of environmental systems
2. Study atmospheric, aquatic, and soil chemistry
3. Analyze pollutant behavior and transformation
4. Apply chemistry to sustainability challenges
5. Develop analytical perspective on environmental quality

Course Outcomes
CO1 Explain chemical composition of air and water
CO2 Analyze chemical reactions in natural systems
CO3 Understand pollutant transport and fate
CO4 Apply chemistry in environmental assessment
CO5 Interpret chemical data for sustainability decisions

Detailed Syllabus

Unit I: Environmental chemistry fundamentals; chemical equilibrium, kinetics; acid base reactions; redox processes; relevance to natural systems, environmental transformations, chemical speciation, analytical considerations, sustainability context.

Unit II: Atmospheric chemistry; composition of troposphere and stratosphere; photochemical reactions; ozone chemistry; air pollutants, smog formation, chemical cycles, climate interactions, environmental implications.

Unit III: Aquatic chemistry; water quality parameters; dissolved oxygen, alkalinity, hardness; chemical reactions in water bodies, nutrient cycles, contamination processes, analytical indicators, sustainability relevance.

Unit IV: Soil and sediment chemistry; adsorption, ion exchange; organic matter interactions; nutrient availability; contaminant mobility, chemical buffering, environmental remediation principles, sustainable land management.

Unit V: Environmental pollution chemistry; heavy metals, pesticides, industrial chemicals; degradation pathways; bioaccumulation, toxicity; chemical risk assessment, pollution control strategies, regulatory perspectives.

Text Books

1. Manahan, S. E. (2017). *Environmental chemistry* (10th ed.). CRC Press.
2. Baird, C., & Cann, M. (2012). *Environmental chemistry* (5th ed.). W. H. Freeman.
3. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2003). *Chemistry for environmental engineering and science* (5th ed.). McGraw-Hill.
4. Stumm, W., & Morgan, J. J. (1996). *Aquatic chemistry* (3rd ed.). Wiley.
5. Moore, J. W., & Moore, E. A. (1976). *Environmental chemistry*. Academic Press.

Reference Books

1. Vallero, D. A. (2014). *Environmental contaminants*. Academic Press.
2. De Nevers, N. (2010). *Air pollution control engineering* (2nd ed.). McGraw-Hill.
3. Hester, R. E., & Harrison, R. M. (Eds.). (2009). *Chemistry for the environment*. Royal Society of Chemistry.
4. Cunningham, W. P., & Cunningham, M. A. (2018). *Principles of environmental science* (8th ed.). McGraw-Hill.
5. Schwarzenbach, R. P., Gschwend, P. M., & Imboden, D. M. (2016). *Environmental organic chemistry* (3rd ed.). Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Introduction to Sustainability & Climate Change
Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce sustainability concepts and principles
2. Understand climate change science and impacts
3. Examine global and local sustainability challenges
4. Develop systems thinking for sustainable development

5. Build awareness of policy and societal dimensions

Course Outcomes
CO1 Define sustainability and development concepts
CO2 Explain drivers of climate change
CO3 Analyze environmental social interactions
CO4 Understand sustainability frameworks
CO5 Relate climate issues to policy contexts

Detailed Syllabus

Unit I: Sustainability concepts; sustainable development goals; environmental social economic dimensions; systems thinking; intergenerational equity, resource efficiency, resilience, global sustainability challenges, integrative perspectives.

Unit II: Climate change fundamentals; greenhouse gases, radiative forcing; historical climate trends; natural and anthropogenic drivers; climate variability, scientific evidence, observational datasets, uncertainty understanding.

Unit III: Climate change impacts; ecosystems, water resources, agriculture; human health; vulnerability, adaptation capacity; regional impacts, risk assessment, resilience planning, sustainability linkages.

Unit IV: Mitigation strategies; emission reduction pathways; renewable energy, efficiency; carbon sinks; behavioral change, technological options, policy instruments, sustainable transitions.

Unit V: Sustainability governance; international agreements; national policies; climate ethics; equity considerations, stakeholder roles, institutional frameworks, sustainable decision making.

Text Books

1. Griggs, D., et al. (2013). *Sustainable development goals*. Nature Publishing.
2. IPCC. (2021). *Climate change 2021: The physical science basis*. Cambridge University Press.
3. Sachs, J. D. (2015). *The age of sustainable development*. Columbia University Press.
4. Hopwood, B., Mellor, M., & O'Brien, G. (2005). *Sustainable development*. Sustainable Development Journal.
5. Dessler, A. E. (2019). *Introduction to modern climate change* (2nd ed.). Cambridge University Press.

Reference Books

1. Meadows, D. H. (2008). *Thinking in systems*. Chelsea Green.
2. Stern, N. (2007). *The economics of climate change*. Cambridge University Press.

3. Giddens, A. (2011). *The politics of climate change*. Polity Press.
4. Rockström, J., et al. (2009). *Planetary boundaries*. Ecology and Society.
5. UNEP. (2019). *Global environment outlook*. United Nations.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Programming Fundamentals (Python for Data Analysis)
Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce programming concepts using Python
2. Develop problem solving and logical thinking skills
3. Apply programming to data analysis tasks
4. Use computational tools for sustainability datasets
5. Build foundation for advanced analytical methods

Course Outcomes
CO1 Write basic Python programs
CO2 Use control structures and functions
CO3 Handle data structures effectively
CO4 Perform basic data analysis tasks
CO5 Apply programming to environmental data

Detailed Syllabus

Unit I: Programming basics; algorithms, flowcharts; Python syntax, variables, data types; input output operations; logical thinking, problem decomposition, computational approach for scientific data.

Unit II: Control structures; conditional statements; loops; iteration logic; nested structures; problem solving patterns, efficiency considerations, program correctness, practical coding skills.

Unit III: Data structures; lists, tuples, dictionaries, sets; operations and methods; data organization, manipulation, storage; application to structured environmental datasets.

Unit IV: Functions and modules; user defined functions; parameters, return values; standard libraries; modular programming, code reusability, scientific computing orientation.

Unit V: Introduction to data analysis; file handling; basic numerical operations; simple visualization concepts; application to sustainability datasets, computational interpretation, analytical workflows.

Text Books

1. Guttag, J. V. (2021). *Introduction to computation and programming using Python* (3rd ed.). MIT Press.
2. Sweigart, A. (2020). *Automate the boring stuff with Python* (2nd ed.). No Starch Press.
3. Lutz, M. (2013). *Learning Python* (5th ed.). O'Reilly Media.
4. McKinney, W. (2018). *Python for data analysis* (2nd ed.). O'Reilly Media.
5. Downey, A. B. (2015). *Think Python* (2nd ed.). O'Reilly Media.

Reference Books

1. Summerfield, M. (2018). *Programming in Python 3* (2nd ed.). Addison-Wesley.
2. VanderPlas, J. (2016). *Python data science handbook*. O'Reilly Media.
3. Langtangen, H. P. (2016). *A primer on scientific programming with Python*. Springer.
4. Grus, J. (2019). *Data science from scratch* (2nd ed.). O'Reilly Media.
5. Severance, C. (2016). *Python for everybody*. CreateSpace.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Communication Skills & Professional English
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Enhance professional communication skills
2. Develop academic and workplace English proficiency
3. Improve listening, speaking, reading abilities
4. Build confidence in presentations and interactions
5. Prepare students for professional environments

Course Outcomes
CO1 Use English effectively in professional contexts
CO2 Demonstrate improved oral communication

CO3 Apply reading and writing skills
CO4 Participate in group discussions
CO5 Deliver structured presentations

Detailed Syllabus

Unit I: Communication process; verbal nonverbal communication; barriers; listening skills; interpersonal interaction, professional contexts, academic environments, effectiveness improvement strategies.

Unit II: Vocabulary development; functional grammar; sentence structures; clarity and coherence; professional usage, contextual appropriateness, accuracy, language refinement.

Unit III: Reading skills; comprehension strategies; technical texts; summarization; information extraction, critical reading, academic relevance, efficiency improvement.

Unit IV: Writing skills; paragraphs, reports, emails; formal tone; coherence; documentation basics, professional correspondence, structured expression.

Unit V: Oral communication; presentations; group discussions; interviews; confidence building, articulation, audience awareness, professional interaction skills.

Text Books

1. Murphy, R. (2019). *English grammar in use* (5th ed.). Cambridge University Press.
2. Kumar, S., & Pushp, L. (2015). *Communication skills*. Oxford University Press.
3. Bhatia, V. K. (2014). *Worlds of written discourse*. Bloomsbury.
4. Eastwood, J. (2011). *Oxford practice grammar*. Oxford University Press.
5. Thomson, A. J., & Martinet, A. V. (2010). *A practical English grammar*. Oxford University Press.

Reference Books

1. Raman, M., & Sharma, S. (2011). *Technical communication*. Oxford University Press.
2. Hewings, M. (2013). *Advanced grammar in use*. Cambridge University Press.
3. Bailey, S. (2018). *Academic writing* (4th ed.). Routledge.
4. Leech, G., & Svartvik, J. (2002). *A communicative grammar of English*. Pearson.
5. Gerson, S. J., & Gerson, S. M. (2017). *Technical communication*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Laboratory Practice I (Environmental Science)
Course Category: Basic Science Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Develop basic laboratory skills in environmental science
2. Apply theoretical concepts through experiments
3. Understand environmental measurement techniques
4. Practice data recording and interpretation
5. Build safety and ethical laboratory practices

Course Outcomes
CO1 Perform basic environmental experiments
CO2 Use laboratory instruments correctly
CO3 Record and analyze experimental data
CO4 Follow safety protocols
CO5 Interpret environmental quality parameters

List of Experiments / Exercises

1. Measurement of pH of water samples using pH meter, calibration procedures, data recording, interpretation of acidity alkalinity relevance.
2. Determination of turbidity in water samples using turbidity meter, sample handling, analysis of water quality implications.
3. Estimation of dissolved oxygen by Winkler method, titration technique, calculation, interpretation for aquatic health.
4. Measurement of total dissolved solids using conductivity meter, correlation with water quality standards, analytical skills.
5. Analysis of alkalinity of water samples using titration, endpoint detection, environmental significance.
6. Determination of hardness of water using EDTA titration, calculation, relevance to domestic and industrial use.
7. Measurement of ambient temperature and humidity using hygrometer, data logging, microclimate understanding.
8. Particulate matter sampling using simple air sampler, mass measurement, air quality interpretation.
9. Soil moisture determination using gravimetric method, sampling technique, relevance to agriculture sustainability.

10. Noise level measurement using sound level meter, data interpretation, environmental standards awareness.

Expected Outcomes
Practical understanding of environmental parameters; improved laboratory discipline; ability to relate experimental data with sustainability indicators.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER II

Course 1

Course Title: Mathematics II (Probability & Statistics)
Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Build probabilistic foundations for uncertainty analysis
2. Apply statistical methods to environmental datasets
3. Understand random variables and distributions
4. Perform data interpretation using inferential statistics
5. Support quantitative decision making in sustainability studies

Course Outcomes
CO1 Apply probability laws to practical problems
CO2 Use discrete and continuous distributions
CO3 Perform descriptive statistical analysis
CO4 Apply sampling and estimation techniques
CO5 Interpret statistical results for environmental data

Detailed Syllabus

Unit I: Probability fundamentals; sample space, events; axioms of probability; conditional probability, Bayes theorem; applications to environmental uncertainty, risk assessment, data interpretation, quantitative reasoning frameworks.

Unit II: Random variables; discrete and continuous distributions; binomial, Poisson, normal distributions; mean, variance; environmental data modeling, event frequency analysis, probabilistic interpretation techniques.

Unit III: Descriptive statistics; measures of central tendency, dispersion; skewness, kurtosis; graphical representation; environmental datasets summarization, exploratory data analysis, comparative interpretation methods.

Unit IV: Sampling theory; random sampling methods; sampling distributions; estimation; confidence intervals; environmental surveys, data reliability assessment, statistical accuracy evaluation, applied inference concepts.

Unit V: Hypothesis testing; null and alternative hypotheses; tests for means and variances; correlation, regression basics; environmental trend analysis, data driven decision support, sustainability applications.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). *Probability and statistics for engineers and scientists* (9th ed.). Pearson.
2. Devore, J. L. (2016). *Probability and statistics for engineering and the sciences* (9th ed.). Cengage Learning.
3. Ross, S. M. (2014). *Introduction to probability and statistics for engineers and scientists* (5th ed.). Academic Press.
4. Montgomery, D. C., & Runger, G. C. (2018). *Applied statistics and probability for engineers* (7th ed.). Wiley.
5. Spiegel, M. R., Schiller, J. J., & Srinivasan, R. A. (2017). *Schaum's outline of probability and statistics* (4th ed.). McGraw-Hill.

Reference Books

1. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2019). *Probability and statistical inference* (9th ed.). Pearson.
2. Freund, J. E. (2003). *Mathematical statistics*. Pearson.
3. Box, G. E. P., Hunter, J. S., & Hunter, W. G. (2005). *Statistics for experimenters*. Wiley.
4. Everitt, B. S., & Skrondal, A. (2010). *The Cambridge dictionary of statistics* (4th ed.). Cambridge University Press.
5. Chatterjee, S., & Hadi, A. S. (2012). *Regression analysis by example* (5th ed.). Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Ecology & Biodiversity Conservation
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand ecological principles and processes
2. Study ecosystem structure and function
3. Analyze biodiversity patterns and threats
4. Examine conservation strategies and frameworks
5. Promote ecological sustainability perspectives

Course Outcomes
CO1 Explain ecological concepts and energy flows
CO2 Analyze population and community dynamics
CO3 Understand biodiversity distribution patterns
CO4 Evaluate conservation approaches
CO5 Relate ecology to sustainability challenges

Detailed Syllabus

Unit I: Ecology fundamentals; ecosystem concepts; biotic abiotic components; energy flow, nutrient cycles; trophic levels, productivity, ecosystem stability, environmental interrelationships.

Unit II: Population ecology; population growth models; carrying capacity; species interactions; predation, competition; population regulation mechanisms, ecological balance concepts.

Unit III: Community ecology; species diversity; ecological succession; community structure; keystone species; habitat complexity, ecosystem resilience, biodiversity maintenance principles.

Unit IV: Biodiversity patterns; genetic, species, ecosystem diversity; biogeographic zones; endemism; biodiversity hotspots, environmental gradients, conservation significance.

Unit V: Conservation biology; threats to biodiversity; habitat loss, climate change; conservation strategies; protected areas, policy frameworks, sustainable management approaches.

Text Books

1. Odum, E. P., & Barrett, G. W. (2005). *Fundamentals of ecology* (5th ed.). Brooks Cole.
2. Begon, M., Townsend, C. R., & Harper, J. L. (2006). *Ecology: From individuals to ecosystems* (4th ed.). Blackwell.
3. Primack, R. B. (2014). *Essentials of conservation biology* (6th ed.). Sinauer.
4. Molles, M. C. (2016). *Ecology: Concepts and applications* (7th ed.). McGraw-Hill.
5. Groom, M. J., Meffe, G. K., & Carroll, C. R. (2006). *Principles of conservation biology* (3rd ed.). Sinauer.

Reference Books

1. Krebs, C. J. (2009). *Ecology* (6th ed.). Pearson.
2. Smith, T. M., & Smith, R. L. (2015). *Elements of ecology* (9th ed.). Pearson.
3. Gaston, K. J., & Spicer, J. I. (2004). *Biodiversity: An introduction* (2nd ed.). Blackwell.

4. UNEP. (2010). *Global biodiversity outlook*. United Nations.
5. Wilson, E. O. (2016). *Half-earth*. Liveright.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Renewable Energy Fundamentals
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce renewable energy concepts
2. Understand energy resource availability
3. Study basic renewable energy technologies
4. Evaluate sustainability aspects of renewables
5. Build foundation for advanced energy systems

Course Outcomes
CO1 Explain renewable energy principles
CO2 Identify various renewable resources
CO3 Understand basic energy conversion methods
CO4 Evaluate environmental benefits
CO5 Relate renewables to energy transition

Detailed Syllabus

Unit I: Energy fundamentals; conventional versus renewable sources; global energy scenario; sustainability drivers; resource assessment concepts, energy demand trends, environmental implications.

Unit II: Solar energy basics; solar radiation characteristics; thermal and photovoltaic principles; energy conversion fundamentals, performance parameters, sustainability relevance.

Unit III: Wind energy principles; wind characteristics; turbine concepts; power extraction basics; site considerations, environmental impacts, renewable integration.

Unit IV: Bioenergy fundamentals; biomass resources; conversion processes; biogas, biofuels; energy yield concepts, sustainability considerations, waste utilization.

Unit V: Small hydro and emerging renewables; ocean energy basics; hybrid systems; renewable integration challenges, grid considerations, sustainable energy planning.

Text Books

1. Boyle, G. (2012). *Renewable energy* (3rd ed.). Oxford University Press.
2. Twidell, J., & Weir, T. (2015). *Renewable energy resources* (3rd ed.). Routledge.
3. Duffie, J. A., & Beckman, W. A. (2013). *Solar engineering of thermal processes* (4th ed.). Wiley.
4. Manwell, J. F., McGowan, J. G., & Rogers, A. L. (2010). *Wind energy explained* (2nd ed.). Wiley.
5. Kaltschmitt, M., Streicher, W., & Wiese, A. (2007). *Renewable energy*. Springer.

Reference Books

1. Lund, H. (2014). *Renewable energy systems*. Academic Press.
2. Sorensen, B. (2011). *Renewable energy* (4th ed.). Academic Press.
3. Godfrey Boyle. (2017). *Energy systems and sustainability*. Oxford University Press.
4. Tester, J. W., et al. (2012). *Sustainable energy*. MIT Press.
5. Ellabban, O., Abu-Rub, H., & Blaabjerg, F. (2014). *Renewable energy resources*. Renewable Energy Journal.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Basics of Electrical & Energy Systems
Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce basic electrical engineering concepts
2. Understand energy generation and distribution
3. Study electrical components and systems
4. Relate electrical principles to energy applications
5. Support interdisciplinary sustainability learning

Course Outcomes
CO1 Explain electrical quantities and laws
CO2 Analyze simple electrical circuits
CO3 Understand energy systems fundamentals
CO4 Identify components in power systems
CO5 Relate electrical concepts to renewables

Detailed Syllabus

Unit I: Electrical quantities; current, voltage, resistance; Ohm's law; electrical power and energy; measurement units, basic circuit concepts, sustainability relevance.

Unit II: DC circuits; series parallel networks; Kirchhoff laws; network analysis techniques; energy calculations, practical applications, electrical system understanding.

Unit III: AC fundamentals; sinusoidal quantities; frequency, phase; single phase AC circuits; power concepts, energy efficiency considerations.

Unit IV: Electrical machines overview; transformers, motors, generators; operating principles; energy conversion basics, system role understanding.

Unit V: Power systems overview; generation, transmission, distribution; grid fundamentals; renewable integration basics, sustainable energy systems context.

Text Books

1. Hughes, E. (2019). *Electrical and electronic technology* (12th ed.). Pearson.
2. Theraja, B. L., & Theraja, A. K. (2018). *A textbook of electrical technology*. S. Chand.
3. Bird, J. (2014). *Electrical and electronic principles and technology* (5th ed.). Routledge.
4. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2013). *Electric machinery* (7th ed.). McGraw-Hill.
5. Sen, P. C. (2016). *Principles of electric machines and power electronics* (3rd ed.). Wiley.

Reference Books

1. Gonen, T. (2013). *Electric power distribution engineering* (3rd ed.). CRC Press.
2. Weedy, B. M., Cory, B. J., Jenkins, N., & Ekanayake, J. (2012). *Electric power systems* (5th ed.). Wiley.
3. Chapman, S. J. (2011). *Electric machinery fundamentals* (5th ed.). McGraw-Hill.
4. Wildi, T. (2006). *Electrical machines, drives, and power systems* (6th ed.). Pearson.
5. El-Sharkawi, M. A. (2012). *Electric energy*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Materials Science for Sustainable Technologies
Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand materials structure and properties
2. Study materials used in sustainable technologies
3. Relate material selection to environmental impact
4. Introduce advanced functional materials
5. Support sustainable engineering design

Course Outcomes
CO1 Explain structure property relationships
CO2 Identify materials for energy applications
CO3 Understand degradation and recyclability
CO4 Evaluate material sustainability aspects
CO5 Apply material knowledge to technology selection

Detailed Syllabus

Unit I: Materials science fundamentals; atomic structure; bonding; crystal structures; defects; structure property relationships, engineering relevance, sustainability considerations.

Unit II: Metals and alloys; mechanical properties; corrosion basics; protection methods; durability, lifecycle considerations, sustainable material usage.

Unit III: Ceramics and glasses; properties; applications in energy systems; thermal behavior; environmental stability, sustainability relevance.

Unit IV: Polymers and composites; structure; properties; applications; recyclability, environmental impact, sustainable material design.

Unit V: Advanced materials; semiconductors, nanomaterials; functional materials; applications in renewable energy, sustainability oriented technologies.

Text Books

1. Callister, W. D., & Rethwisch, D. G. (2018). *Materials science and engineering* (10th ed.). Wiley.
2. Shackelford, J. F. (2015). *Introduction to materials science for engineers* (8th ed.). Pearson.
3. Ashby, M. F. (2017). *Materials and sustainable development*. Butterworth-Heinemann.

4. Smith, W. F., & Hashemi, J. (2010). *Foundations of materials science and engineering* (5th ed.). McGraw-Hill.
5. Rao, C. N. R., Müller, A., & Cheetham, A. K. (2004). *The chemistry of nanomaterials*. Wiley-VCH.

Reference Books

1. Allen, D. T., & Shonnard, D. R. (2012). *Sustainable engineering*. Pearson.
2. Ashby, M. F. (2013). *Materials selection in mechanical design* (4th ed.). Butterworth-Heinemann.
3. Ratner, B. D., et al. (2013). *Biomaterials science*. Academic Press.
4. Freund, L. B., & Suresh, S. (2004). *Thin film materials*. Cambridge University Press.
5. Cao, G., & Wang, Y. (2011). *Nanostructures and nanomaterials*. World Scientific.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Design Thinking for Sustainability
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce design thinking methodology
2. Apply human centered design to sustainability
3. Develop creative problem solving skills
4. Integrate interdisciplinary perspectives
5. Support innovation for sustainable solutions

Course Outcomes
CO1 Understand design thinking principles
CO2 Apply empathy based problem identification
CO3 Generate creative sustainability solutions
CO4 Prototype and evaluate concepts
CO5 Collaborate in interdisciplinary teams

Detailed Syllabus

Unit I: Design thinking concepts; human centered design; sustainability challenges; problem framing, systems perspective, innovation context.

Unit II: Empathy and need identification; stakeholder analysis; observation techniques; sustainability focused problem definition.

Unit III: Ideation methods; brainstorming; creative tools; solution generation; sustainability driven innovation concepts.

Unit IV: Prototyping basics; low fidelity models; testing approaches; feedback integration; iterative improvement.

Unit V: Implementation perspectives; feasibility, viability; sustainability assessment; impact evaluation, design communication.

Text Books

1. Brown, T. (2009). *Change by design*. Harper Business.
2. Liedtka, J., & Ogilvie, T. (2011). *Designing for growth*. Columbia University Press.
3. IDEO.org. (2015). *The field guide to human centered design*. IDEO.
4. Stickdorn, M., & Schneider, J. (2011). *This is service design thinking*. BIS Publishers.
5. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.

Reference Books

1. Buchanan, R. (1992). *Wicked problems in design thinking*. Design Issues.
2. Cross, N. (2011). *Design thinking*. Berg.
3. Elkington, J. (1997). *Cannibals with forks*. Capstone.
4. Meadows, D. H. (2008). *Thinking in systems*. Chelsea Green.
5. Manzini, E. (2015). *Design, when everybody designs*. MIT Press.

Evaluation Scheme
Continuous Assessment (100%)

Internship / Field Orientation
Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to environmental field practices
2. Familiarize students with sustainability organizations
3. Develop observational and reporting skills
4. Connect theory with real world applications

5. Build professional orientation

Course Outcomes
CO1 Observe sustainability practices in field settings
CO2 Document field activities systematically
CO3 Relate academic concepts to practice
CO4 Demonstrate professional conduct
CO5 Prepare structured field reports

Guidelines
Identification of industry, NGO, laboratory, or field site; supervised engagement; defined learning objectives; maintenance of activity log; submission of field report.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER III

Course 1

Course Title: Climate Science & Atmospheric Systems
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand physical basis of climate systems
2. Analyze atmospheric structure and processes
3. Examine climate variability and change mechanisms
4. Interpret observational climate data
5. Relate atmospheric science to sustainability challenges

Course Outcomes
CO1 Explain climate system components and interactions
CO2 Analyze atmospheric circulation processes
CO3 Interpret climate variability and trends
CO4 Understand feedback mechanisms in climate systems
CO5 Apply climate science concepts to impact analysis

Detailed Syllabus

Unit I: Climate system components; atmosphere, hydrosphere, cryosphere, lithosphere, biosphere; energy balance concepts; system interactions, feedback loops, temporal spatial scales, climate forcing factors, integrative Earth system perspective.

Unit II: Atmospheric structure; troposphere, stratosphere, mesosphere, thermosphere; temperature profiles, pressure gradients; circulation cells, jet streams, Coriolis effects, large scale atmospheric dynamics, climate relevance.

Unit III: Radiation balance; solar terrestrial radiation; absorption, scattering, reflection; greenhouse gases, radiative forcing; climate sensitivity, forcing response relationships, global energy equilibrium assessment.

Unit IV: Climate variability; natural variability modes; ENSO, monsoon systems; ocean atmosphere coupling; short term long term variations, observational evidence, climate signal interpretation frameworks.

Unit V: Climate change science; anthropogenic drivers; emissions trends; feedback mechanisms; uncertainty sources, climate projections, scenario frameworks, scientific consensus foundations.

Text Books

1. Hartmann, D. L. (2016). *Global physical climatology* (2nd ed.). Elsevier.
2. Wallace, J. M., & Hobbs, P. V. (2006). *Atmospheric science: An introductory survey* (2nd ed.). Academic Press.
3. IPCC. (2021). *Climate change 2021: The physical science basis*. Cambridge University Press.
4. Peixoto, J. P., & Oort, A. H. (1992). *Physics of climate*. American Institute of Physics.
5. Lutgens, F. K., Tarbuck, E. J., & Tasa, D. (2017). *The atmosphere* (13th ed.). Pearson.

Reference Books

1. Salby, M. L. (2012). *Physics of the atmosphere and climate*. Cambridge University Press.
2. Andrews, D. G. (2010). *An introduction to atmospheric physics* (2nd ed.). Cambridge University Press.
3. Ruddiman, W. F. (2013). *Earth's climate: Past and future* (3rd ed.). W. H. Freeman.
4. Trenberth, K. E. (2011). *Climate system modeling*. Cambridge University Press.
5. Pierrehumbert, R. T. (2010). *Principles of planetary climate*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Energy Conversion & Storage Technologies
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand principles of energy conversion
2. Study conventional and renewable conversion systems
3. Analyze energy storage technologies
4. Evaluate efficiency and sustainability aspects
5. Support low carbon energy transition knowledge

Course Outcomes
CO1 Explain energy conversion mechanisms
CO2 Analyze thermal and electrochemical systems
CO3 Understand storage technologies and applications

CO4 Evaluate performance and efficiency parameters
CO5 Relate technologies to sustainable energy systems

Detailed Syllabus

Unit I: Energy conversion fundamentals; energy forms; thermodynamic limits; efficiency concepts; first second law relevance, system boundaries, sustainability implications, energy quality assessment.

Unit II: Thermal energy conversion; heat engines; power cycles basics; combustion principles; efficiency factors, emissions considerations, low carbon transition relevance.

Unit III: Electrochemical conversion; batteries, fuel cells; operating principles; performance metrics; materials considerations, sustainability aspects, energy storage roles.

Unit IV: Mechanical and electrical storage; pumped hydro, flywheels; capacitors; storage characteristics, response time, grid integration considerations.

Unit V: Emerging storage technologies; hydrogen storage; thermal storage; hybrid systems; technology assessment, lifecycle considerations, future energy system integration.

Text Books

1. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. B. (2018). *Fundamentals of engineering thermodynamics* (9th ed.). Wiley.
2. Larminie, J., & Dicks, A. (2003). *Fuel cell systems explained* (2nd ed.). Wiley.
3. Linden, D., & Reddy, T. B. (2011). *Handbook of batteries* (4th ed.). McGraw-Hill.
4. Khaligh, A., & Li, Z. (2010). *Battery, ultracapacitor, fuel cell systems*. CRC Press.
5. Dunn, B., Kamath, H., & Tarascon, J. M. (2011). *Electrical energy storage*. Science.

Reference Books

1. Winter, M., & Brodd, R. J. (2004). *What are batteries*. Chemical Reviews.
2. Sorensen, B. (2011). *Renewable energy* (4th ed.). Academic Press.
3. Kaltschmitt, M., et al. (2007). *Renewable energy*. Springer.
4. Crabtree, G. W., & Lewis, N. S. (2007). *Solar energy conversion*. Physics Today.
5. Lund, H. (2014). *Renewable energy systems*. Academic Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Environmental Monitoring & Instrumentation
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce environmental monitoring principles
2. Understand measurement techniques and sensors
3. Study instrumentation for air water soil analysis
4. Interpret environmental data accurately
5. Support compliance and sustainability monitoring

Course Outcomes
CO1 Identify monitoring parameters and standards
CO2 Explain sensor and instrument principles
CO3 Apply sampling and measurement techniques
CO4 Analyze monitoring data
CO5 Relate monitoring to environmental management

Detailed Syllabus

Unit I: Environmental monitoring concepts; monitoring objectives; standards and regulations; sampling strategies; spatial temporal variability, data quality assurance, sustainability relevance.

Unit II: Air quality monitoring; pollutants, sampling methods; particulate gaseous measurements; instruments principles, calibration, data interpretation frameworks.

Unit III: Water quality monitoring; physical chemical biological parameters; sensors and analyzers; sampling protocols, quality control, environmental assessment applications.

Unit IV: Soil and noise monitoring; soil properties; contamination indicators; noise measurement techniques; environmental impact relevance, regulatory compliance.

Unit V: Data acquisition systems; remote sensing basics; telemetry; data logging; monitoring networks, integrated environmental information systems.

Text Books

1. Rao, C. S. (2014). *Environmental pollution control engineering*. New Age International.
2. Peavy, H. S., & Row, K. (1985). *Environmental engineering*. McGraw-Hill.
3. Manahan, S. E. (2017). *Environmental chemistry* (10th ed.). CRC Press.
4. Wark, K., Warner, C. F., & Davis, W. T. (1998). *Air pollution* (3rd ed.). Addison-Wesley.

5. Metcalf & Eddy. (2014). *Wastewater engineering* (5th ed.). McGraw-Hill.

Reference Books

1. Sawyer, C. N., et al. (2003). *Chemistry for environmental engineering*. McGraw-Hill.
2. Davis, M. L., & Cornwell, D. A. (2013). *Introduction to environmental engineering* (5th ed.). McGraw-Hill.
3. Spellman, F. R. (2017). *Handbook of water and wastewater treatment*. CRC Press.
4. UNEP. (2019). *Global environment outlook*. United Nations.
5. WHO. (2018). *Environmental health criteria*. World Health Organization.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Geographic Information Systems (GIS)
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce spatial data concepts
2. Understand GIS components and data models
3. Apply GIS tools for environmental analysis
4. Interpret spatial patterns and relationships
5. Support decision making in sustainability planning

Course Outcomes
CO1 Explain GIS concepts and data structures
CO2 Use spatial data for mapping applications
CO3 Perform basic spatial analysis
CO4 Interpret GIS outputs for environment studies
CO5 Apply GIS in sustainability assessments

Detailed Syllabus

Unit I: GIS fundamentals; spatial data concepts; raster vector models; coordinate systems; map projections, scale, spatial accuracy considerations.

Unit II: Data acquisition; remote sensing sources; GPS basics; digitization; data quality issues, metadata, environmental datasets preparation.

Unit III: Spatial analysis; overlay operations; buffering; network analysis basics; environmental modeling applications, pattern recognition.

Unit IV: GIS applications; land use mapping; watershed analysis; urban environment studies; sustainability planning support.

Unit V: GIS visualization; thematic mapping; spatial databases; decision support systems; environmental management integration.

Text Books

1. Burrough, P. A., & McDonnell, R. A. (2015). *Principles of geographical information systems*. Oxford University Press.
2. Longley, P. A., et al. (2015). *Geographic information systems and science* (4th ed.). Wiley.
3. DeMers, M. N. (2017). *Fundamentals of geographic information systems*. Wiley.
4. Chang, K. T. (2019). *Introduction to geographic information systems* (9th ed.). McGraw-Hill.
5. Heywood, I., Cornelius, S., & Carver, S. (2011). *An introduction to geographical information systems* (4th ed.). Pearson.

Reference Books

1. Campbell, J. B., & Wynne, R. H. (2011). *Introduction to remote sensing* (5th ed.). Guilford.
2. Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). *Remote sensing and image interpretation* (7th ed.). Wiley.
3. Jensen, J. R. (2015). *Introductory digital image processing* (4th ed.). Pearson.
4. ESRI. (2018). *GIS handbook*. ESRI Press.
5. UNDP. (2016). *GIS for sustainable development*. United Nations.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Sustainable Water Resources Management
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand hydrological cycle and water systems
2. Analyze water resource availability and demand
3. Study water management strategies
4. Evaluate sustainability and policy dimensions

5. Promote integrated water resources management

Course Outcomes
CO1 Explain hydrological processes
CO2 Analyze surface and groundwater systems
CO3 Evaluate water management techniques
CO4 Understand policy and governance aspects
CO5 Apply sustainability principles to water planning

Detailed Syllabus

Unit I: Hydrological cycle; precipitation, runoff, infiltration; evaporation; basin concepts, water balance, climate interactions, sustainability relevance.

Unit II: Surface water resources; rivers, reservoirs; flow measurement; water availability assessment, variability analysis, management challenges.

Unit III: Groundwater systems; aquifers; recharge discharge; quality issues; overexploitation impacts, sustainability considerations.

Unit IV: Water demand management; agriculture, industry, domestic use; conservation strategies; efficiency improvement, reuse concepts.

Unit V: Integrated water resources management; policy frameworks; stakeholder participation; climate change impacts, adaptive strategies.

Text Books

1. Maidment, D. R. (1993). *Handbook of hydrology*. McGraw-Hill.
2. Gupta, R. S. (2016). *Hydrology and hydraulic systems* (4th ed.). Waveland Press.
3. Ward, R. C., & Robinson, M. (2000). *Principles of hydrology* (4th ed.). McGraw-Hill.
4. Gleick, P. H. (2014). *The world's water*. Island Press.
5. Loucks, D. P., & van Beek, E. (2017). *Water resource systems planning and management*. Springer.

Reference Books

1. UNESCO. (2019). *World water development report*. United Nations.
2. Falkenmark, M., & Rockström, J. (2004). *Balancing water for humans and nature*. Earthscan.
3. Biswas, A. K. (2008). *Integrated water resources management*. Oxford University Press.
4. WWAP. (2018). *Water and climate change*. United Nations.
5. FAO. (2017). *Water management guidelines*. FAO.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Humanities Elective (Environmental Ethics / Indian Knowledge Systems)
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce ethical perspectives on environment
2. Examine traditional Indian knowledge systems
3. Relate ethics to sustainability challenges
4. Develop value based environmental understanding
5. Support responsible decision making

Course Outcomes
CO1 Explain environmental ethical principles
CO2 Understand Indian traditional sustainability practices
CO3 Analyze ethical dimensions of development
CO4 Relate culture to environmental stewardship
CO5 Apply ethics in sustainability contexts

Detailed Syllabus

Unit I: Environmental ethics foundations; anthropocentric ecocentric views; moral philosophy; sustainability values, responsibility frameworks.

Unit II: Indian knowledge systems; traditional ecological practices; water, agriculture, forestry; cultural sustainability linkages.

Unit III: Ethics and development; equity justice; intergenerational responsibility; resource use dilemmas, climate ethics.

Unit IV: Environmental governance ethics; policy responsibility; stakeholder roles; corporate environmental ethics.

Unit V: Contemporary ethical challenges; climate change justice; biodiversity ethics; sustainable lifestyles, societal transformation.

Text Books

1. DesJardins, J. R. (2013). *Environmental ethics* (5th ed.). Cengage Learning.
2. Shiva, V. (2016). *Who really feeds the world*. North Atlantic Books.
3. Gadgil, M., & Guha, R. (2013). *This fissured land*. Oxford University Press.

4. Radhakrishnan, S. (2009). *Indian philosophy*. Oxford University Press.
5. Narayanan, Y. (2018). *Religion and sustainability*. Oxford University Press.

Reference Books

1. Attfield, R. (2014). *Environmental ethics*. Polity Press.
2. Gupta, A. K. (2013). *Grassroots innovation*. Penguin.
3. Rolston, H. (2012). *A new environmental ethics*. Routledge.
4. Sen, A. (2009). *The idea of justice*. Harvard University Press.
5. UNEP. (2019). *Ethics and climate change*. United Nations.

Evaluation Scheme
Continuous Assessment (100%)

Internship
Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide field exposure in climate or sustainability sectors
2. Develop professional and observational skills
3. Relate theory with practical applications
4. Understand organizational working environments
5. Strengthen reporting and documentation abilities

Course Outcomes
CO1 Observe real world sustainability practices
CO2 Document technical and field activities
CO3 Relate academic knowledge to practice
CO4 Demonstrate professional discipline
CO5 Prepare structured internship reports

Guidelines
Placement in industry, research institute, NGO, or government organization; defined learning objectives; maintenance of daily log; faculty supervision; submission of internship report.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IV

Course 1

Course Title: Climate Modelling & Data Analytics
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamentals of climate modeling approaches
2. Analyze climate datasets using statistical techniques
3. Interpret model outputs and uncertainties
4. Apply data analytics for climate assessment
5. Support evidence based climate decision making

Course Outcomes
CO1 Explain climate model structures and assumptions
CO2 Analyze observational and simulated climate data
CO3 Interpret variability and trend indicators
CO4 Assess model uncertainty and limitations
CO5 Apply analytics to climate impact studies

Detailed Syllabus

Unit I: Climate modeling fundamentals; conceptual, statistical, dynamical models; spatial temporal scales; boundary initial conditions; parameterization concepts, model hierarchy, strengths limitations, application domains, sustainability relevance.

Unit II: General circulation models; atmosphere ocean coupling; grid resolution; physical processes representation; numerical methods overview, computational considerations, climate simulation frameworks, long term projections.

Unit III: Climate data sources; observational datasets, reanalysis products; data preprocessing; quality control; bias correction methods, temporal aggregation, spatial interpolation, analytical consistency.

Unit IV: Climate data analytics; trend analysis; variability indices; anomaly detection; time series analysis, correlation techniques, attribution studies, interpretation frameworks.

Unit V: Uncertainty and scenario analysis; emission scenarios; ensemble modeling; downscaling concepts; impact assessment linkages, policy relevance, decision support applications.

Text Books

1. McGuffie, K., & Henderson-Sellers, A. (2014). *A climate modelling primer* (4th ed.). Wiley-Blackwell.
2. Washington, W. M., & Parkinson, C. L. (2005). *An introduction to three-dimensional climate modeling* (2nd ed.). University Science Books.
3. Wilks, D. S. (2019). *Statistical methods in the atmospheric sciences* (4th ed.). Academic Press.
4. Von Storch, H., & Zwiers, F. W. (2001). *Statistical analysis in climate research*. Cambridge University Press.
5. IPCC. (2021). *Climate change 2021: The physical science basis*. Cambridge University Press.

Reference Books

1. Trenberth, K. E. (2011). *Climate system modeling*. Cambridge University Press.
2. Jolliffe, I. T., & Stephenson, D. B. (2012). *Forecast verification*. Wiley.
3. Cressie, N., & Wikle, C. K. (2011). *Statistics for spatio-temporal data*. Wiley.
4. Storch, H. V. (1999). *Analysis of climate variability*. Springer.
5. Randall, D. A. (2013). *Atmosphere, clouds, and climate*. Princeton University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Solar, Wind & Bioenergy Systems
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of major renewable systems
2. Study design aspects of solar wind bioenergy
3. Analyze performance characteristics
4. Evaluate environmental and sustainability impacts
5. Support renewable deployment planning

Course Outcomes
CO1 Explain operating principles of renewable systems
CO2 Analyze system components and configurations
CO3 Evaluate performance parameters

CO4 Assess sustainability implications
CO5 Relate technologies to energy transition

Detailed Syllabus

Unit I: Solar energy systems; photovoltaic modules; solar thermal collectors; system components; performance parameters, efficiency factors, installation considerations, sustainability benefits.

Unit II: Wind energy systems; wind resource assessment; turbine components; power curves; site selection criteria, environmental considerations, operational characteristics.

Unit III: Bioenergy systems; biomass resources; conversion pathways; biogas, biofuels; system configurations, yield estimation, sustainability aspects.

Unit IV: Hybrid renewable systems; solar wind bioenergy integration; storage interface; control basics; reliability enhancement, grid interaction concepts.

Unit V: Renewable system assessment; techno economic analysis; lifecycle considerations; policy incentives; deployment challenges, sustainable planning frameworks.

Text Books

1. Twidell, J., & Weir, T. (2015). *Renewable energy resources* (3rd ed.). Routledge.
2. Duffie, J. A., & Beckman, W. A. (2013). *Solar engineering of thermal processes* (4th ed.). Wiley.
3. Manwell, J. F., McGowan, J. G., & Rogers, A. L. (2010). *Wind energy explained* (2nd ed.). Wiley.
4. Kaltschmitt, M., Streicher, W., & Wiese, A. (2007). *Renewable energy*. Springer.
5. Boyle, G. (2012). *Renewable energy* (3rd ed.). Oxford University Press.

Reference Books

1. Lund, H. (2014). *Renewable energy systems*. Academic Press.
2. Sorensen, B. (2011). *Renewable energy* (4th ed.). Academic Press.
3. Tester, J. W., et al. (2012). *Sustainable energy*. MIT Press.
4. Masters, G. M. (2013). *Renewable and efficient electric power systems*. Wiley.
5. Ellabban, O., et al. (2014). *Renewable energy resources*. Renewable Energy Journal.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Sustainable Manufacturing & Circular Economy
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce sustainable manufacturing concepts
2. Understand circular economy principles
3. Analyze resource efficiency strategies
4. Evaluate industrial sustainability practices
5. Support low waste production systems

Course Outcomes
CO1 Explain sustainable manufacturing approaches
CO2 Understand circular material flows
CO3 Analyze industrial resource efficiency
CO4 Evaluate waste minimization strategies
CO5 Apply circular economy concepts

Detailed Syllabus

Unit I: Manufacturing and sustainability; resource consumption patterns; environmental impacts; sustainable production principles, efficiency drivers, regulatory context, industrial transformation needs.

Unit II: Circular economy concepts; material loops; reuse, recycling, remanufacturing; value retention strategies, system thinking, sustainability outcomes.

Unit III: Sustainable process design; cleaner production; energy efficiency; water optimization; emissions reduction, performance indicators.

Unit IV: Industrial symbiosis; by product exchange; eco industrial parks; collaboration models, regional sustainability benefits.

Unit V: Assessment tools; material flow analysis; lifecycle thinking; circular metrics; implementation challenges, policy support.

Text Books

1. Allwood, J. M., et al. (2011). *Sustainable materials*. UIT Cambridge.
2. Graedel, T. E., & Allenby, B. R. (2010). *Industrial ecology* (2nd ed.). Pearson.
3. Jawahir, I. S., & Bradley, R. (2016). *Sustainable manufacturing*. Springer.
4. Stahel, W. R. (2010). *The performance economy*. Palgrave Macmillan.
5. Ashby, M. F. (2017). *Materials and sustainable development*. Butterworth-Heinemann.

Reference Books

1. Allen, D. T., & Shonnard, D. R. (2012). *Sustainable engineering*. Pearson.
2. Ellen MacArthur Foundation. (2015). *Towards a circular economy*. EMF.
3. OECD. (2019). *Business models for the circular economy*. OECD.
4. McDonough, W., & Braungart, M. (2002). *Cradle to cradle*. North Point Press.
5. UNEP. (2017). *Resource efficiency*. United Nations.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Environmental Impact Assessment & Auditing
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand environmental assessment frameworks
2. Study EIA methodologies and procedures
3. Analyze environmental audit processes
4. Interpret regulatory compliance requirements
5. Support sustainable project planning

Course Outcomes
CO1 Explain EIA concepts and objectives
CO2 Apply impact identification methods
CO3 Understand audit and compliance systems
CO4 Analyze mitigation and management plans
CO5 Relate assessment to sustainability decisions

Detailed Syllabus

Unit I: Environmental impact assessment concepts; objectives; legal framework; project lifecycle; screening scoping procedures, sustainability relevance.

Unit II: Impact identification methods; checklists, matrices, networks; baseline data requirements; qualitative quantitative approaches.

Unit III: Impact prediction and evaluation; modeling basics; significance assessment; risk analysis; uncertainty considerations.

Unit IV: Environmental management plans; mitigation measures; monitoring programs; stakeholder participation; adaptive management concepts.

Unit V: Environmental auditing; audit types; ISO standards overview; compliance assessment; reporting frameworks, continual improvement.

Text Books

1. Canter, L. W. (1996). *Environmental impact assessment* (2nd ed.). McGraw-Hill.
2. Glasson, J., Therivel, R., & Chadwick, A. (2012). *Introduction to environmental impact assessment* (4th ed.). Routledge.
3. Wood, C. (2003). *Environmental impact assessment*. Pearson.
4. Noble, B. (2015). *Introduction to environmental impact assessment* (3rd ed.). Oxford University Press.
5. Rao, C. S. (2014). *Environmental pollution control engineering*. New Age International.

Reference Books

1. ISO. (2015). *ISO 14001 environmental management systems*. ISO.
2. UNEP. (2018). *Environmental assessment guidelines*. United Nations.
3. Sadler, B. (1996). *Environmental assessment in a changing world*. IAIA.
4. Morris, P., & Therivel, R. (2009). *Methods of environmental impact assessment*. Routledge.
5. Government of India. (2006). *EIA notification*. MoEFCC.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (Smart Cities / IoT for Environment)
Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce smart city and IoT concepts
2. Understand digital technologies for environment
3. Analyze urban sustainability applications
4. Evaluate technology enabled monitoring systems
5. Support smart environmental management

Course Outcomes
CO1 Explain smart city frameworks

CO2 Understand IoT components and architecture
CO3 Analyze environmental sensing applications
CO4 Evaluate data driven urban solutions
CO5 Relate digital tools to sustainability

Detailed Syllabus

Unit I: Smart city concepts; urban sustainability challenges; infrastructure systems; governance models, digital integration overview.

Unit II: IoT fundamentals; sensors, actuators; communication protocols; data flow architecture, system interoperability.

Unit III: Environmental IoT applications; air water monitoring; waste management; energy systems, real time data utilization.

Unit IV: Data platforms; cloud analytics; dashboards; decision support systems; visualization concepts.

Unit V: Smart city assessment; challenges, security issues; scalability; policy frameworks, sustainability outcomes.

Text Books

1. Townsend, A. M. (2013). *Smart cities*. W. W. Norton.
2. Zanella, A., et al. (2014). *Internet of things for smart cities*. IEEE.
3. Giffinger, R., et al. (2007). *Smart cities ranking*. Centre of Regional Science.
4. Buyya, R., et al. (2013). *Cloud computing*. Morgan Kaufmann.
5. Batty, M. (2018). *Inventing future cities*. MIT Press.

Reference Books

1. Atzori, L., et al. (2010). *The internet of things*. Computer Networks.
2. Kitchin, R. (2014). *The data revolution*. Sage.
3. UN Habitat. (2020). *World cities report*. United Nations.
4. IBM. (2014). *Smarter cities*. IBM Press.
5. OECD. (2020). *Smart cities and inclusive growth*. OECD.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Climate Systems Laboratory
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Apply climate science concepts experimentally
2. Analyze climate and atmospheric datasets
3. Use modeling and visualization tools
4. Interpret climate variability indicators
5. Develop technical reporting skills

Course Outcomes
CO1 Perform climate data analysis exercises
CO2 Use software tools for climate studies
CO3 Interpret observational and model outputs
CO4 Visualize climate indicators effectively
CO5 Prepare structured laboratory reports

List of Experiments / Exercises

1. Analysis of historical temperature datasets using statistical software, computation of trends, anomalies, and interpretation of climate variability indicators.
2. Examination of rainfall time series data for selected regions using data analytics tools, assessment of variability, extremes, and seasonal characteristics.
3. Visualization of global climate datasets using mapping software, creation of spatial plots, interpretation of regional climate patterns.
4. Study of greenhouse gas concentration datasets, trend computation, correlation with temperature indicators, analytical interpretation.
5. Simple energy balance model implementation using computational tools, parameter variation, sensitivity analysis, interpretation of results.
6. Analysis of ENSO indices using time series methods, identification of events, relationship with regional climate impacts.
7. Use of reanalysis datasets for atmospheric variables, extraction of profiles, interpretation of circulation patterns.
8. Scenario based analysis of climate projections, comparison of emission pathways, interpretation of uncertainties.
9. Preparation of climate dashboards using visualization libraries, presentation of indicators for decision support.

10. Case study based analysis of extreme climate events using observational datasets, interpretation of drivers and impacts.
11. Quality control and preprocessing of climate datasets, handling missing data, consistency checks, documentation.
12. Preparation of technical laboratory report integrating data, visualizations, interpretation, and conclusions.

Expected Outcomes
Hands on experience with climate datasets; improved analytical and visualization skills; ability to interpret climate indicators; strengthened technical documentation capability.

Evaluation Scheme
Continuous Assessment (100%)

Internship
Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued industry or research exposure
2. Strengthen applied sustainability understanding
3. Develop professional competencies
4. Enhance documentation and communication skills
5. Support experiential learning

Course Outcomes
CO1 Apply academic knowledge in practical settings
CO2 Demonstrate professional discipline
CO3 Document activities and observations
CO4 Analyze organizational sustainability practices
CO5 Submit comprehensive internship report

Guidelines
Engagement with approved organization; defined scope of work; maintenance of activity log; faculty supervision; submission of internship report.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER V

Course 1

Course Title: Climate Resilient Infrastructure & Technologies
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand climate risks affecting infrastructure systems
2. Analyze resilience concepts for built environment
3. Study technologies enhancing infrastructure adaptability
4. Integrate climate data into infrastructure planning
5. Support sustainable and resilient development strategies

Course Outcomes
CO1 Explain climate hazards impacting infrastructure
CO2 Analyze vulnerability and resilience indicators
CO3 Identify resilient design principles
CO4 Evaluate technology based adaptation options
CO5 Apply resilience concepts to infrastructure planning

Detailed Syllabus

Unit I: Climate risks and infrastructure; extreme events, floods, heatwaves, sea level rise; exposure sensitivity concepts; vulnerability assessment frameworks, risk characterization, infrastructure performance thresholds, resilience terminology, sustainability relevance.

Unit II: Resilience principles; robustness, redundancy, flexibility; adaptive capacity; systems thinking; infrastructure lifelines, interdependencies, cascading failures, resilience metrics, planning integration approaches.

Unit III: Climate resilient design; codes and standards; nature based solutions; green infrastructure; urban drainage, coastal protection, thermal comfort strategies, sustainable material selection.

Unit IV: Infrastructure technologies; smart monitoring systems; sensors, early warning; predictive maintenance; data driven resilience enhancement, digital twins, decision support tools.

Unit V: Policy and planning; resilient infrastructure frameworks; investment prioritization; cost benefit considerations; stakeholder engagement, governance mechanisms, sustainable development alignment.

Text Books

1. IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press.
2. Ayyub, B. M. (2014). *Risk analysis in engineering and economics*. CRC Press.
3. Rogers, C. D. F., et al. (2012). *Resilience of infrastructure systems*. ICE Publishing.
4. Tyler, S., & Moench, M. (2012). *A framework for urban climate resilience*. Climate and Development.
5. World Bank. (2019). *Lifelines: The resilient infrastructure opportunity*. World Bank.

Reference Books

1. UNDRR. (2017). *Disaster risk reduction and resilience*. United Nations.
2. OECD. (2018). *Climate resilient infrastructure*. OECD.
3. Birkmann, J. (2013). *Measuring vulnerability to natural hazards*. UNU Press.
4. Hallegatte, S., et al. (2016). *Shock waves*. World Bank.
5. Moench, M., et al. (2011). *Catalyzing urban climate resilience*. ISET.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Carbon Capture, Utilization & Storage
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand carbon emission sources and mitigation needs
2. Study carbon capture technologies
3. Analyze utilization and storage pathways
4. Evaluate environmental and economic aspects
5. Support low carbon transition strategies

Course Outcomes
CO1 Explain principles of carbon capture
CO2 Differentiate capture technologies
CO3 Understand utilization options
CO4 Analyze storage mechanisms
CO5 Evaluate CCUS role in climate mitigation

Detailed Syllabus

Unit I: Carbon emissions overview; fossil fuel combustion sources; industrial processes; mitigation pathways; role of CCUS in net zero strategies, policy context, technology readiness levels.

Unit II: Carbon capture technologies; pre combustion, post combustion, oxy fuel methods; solvents, sorbents, membranes; efficiency considerations, energy penalties, process integration.

Unit III: Carbon utilization pathways; chemical conversion, fuels, materials; mineralization concepts; circular carbon economy, value creation opportunities, sustainability considerations.

Unit IV: Carbon storage; geological formations; saline aquifers, depleted reservoirs; trapping mechanisms; monitoring verification approaches, risk assessment, long term stability.

Unit V: Environmental and economic assessment; lifecycle analysis; cost estimation; policy incentives; deployment challenges, public perception, climate mitigation effectiveness.

Text Books

1. Rubin, E. S., et al. (2015). *Carbon capture and storage*. Cambridge University Press.
2. Bui, M., et al. (2018). *Carbon capture and storage*. Energy & Environmental Science.
3. IPCC. (2005). *Carbon dioxide capture and storage*. Cambridge University Press.
4. Lackner, K. S. (2012). *Carbon capture*. Annual Review of Energy.
5. Boot-Handford, M. E., et al. (2014). *Carbon capture and storage update*. Energy & Environmental Science.

Reference Books

1. Herzog, H. (2018). *Carbon capture*. MIT Press.
2. Metz, B., et al. (2005). *IPCC special report on CCS*. Cambridge University Press.
3. Olajire, A. A. (2010). *CO2 capture and separation*. Energy.
4. Cuéllar-Franca, R. M., & Azapagic, A. (2015). *CCS environmental impacts*. Journal of Cleaner Production.
5. IEA. (2020). *CCUS in clean energy transitions*. IEA.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Sustainable Agriculture & Food Systems
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand agricultural systems and sustainability challenges
2. Study climate impacts on food production
3. Analyze sustainable farming practices
4. Evaluate food system resilience
5. Support sustainable nutrition and livelihoods

Course Outcomes
CO1 Explain agriculture climate interactions
CO2 Analyze sustainable farming methods
CO3 Understand soil water crop management
CO4 Evaluate food system vulnerabilities
CO5 Apply sustainability principles to agriculture

Detailed Syllabus

Unit I: Agriculture and sustainability; global food systems; productivity challenges; resource constraints; climate variability impacts, food security concepts, sustainability indicators.

Unit II: Climate impacts on agriculture; temperature rainfall effects; crop sensitivity; yield variability; adaptation strategies, risk management approaches.

Unit III: Sustainable farming practices; soil health, organic farming; water efficient irrigation; nutrient management; agroecology principles.

Unit IV: Food systems and supply chains; processing, storage, distribution; losses and waste; energy water nexus considerations.

Unit V: Policy and innovation; climate smart agriculture; digital agriculture tools; farmer livelihoods, resilience building frameworks.

Text Books

1. Pretty, J. (2018). *Sustainable intensification of agriculture*. Routledge.
2. FAO. (2017). *Climate smart agriculture sourcebook*. FAO.
3. Altieri, M. A. (2018). *Agroecology*. CRC Press.
4. Lal, R. (2016). *Soil health and climate change*. Springer.
5. Foley, J. A., et al. (2011). *Solutions for a cultivated planet*. Nature.

Reference Books

1. Godfray, H. C. J., et al. (2010). *Food security*. Science.
2. Rockström, J., et al. (2017). *Sustainable intensification*. Ambio.
3. Pingali, P. (2015). *Agricultural policy*. Elsevier.
4. IPCC. (2019). *Climate change and land*. Cambridge University Press.
5. UNEP. (2021). *Food systems and sustainability*. United Nations.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Environmental Economics & Climate Finance
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce economic principles for environmental issues
2. Analyze market failures and externalities
3. Study climate finance mechanisms
4. Evaluate policy instruments for sustainability
5. Support economic decision making for climate action

Course Outcomes
CO1 Explain environmental economic concepts
CO2 Analyze cost benefit of interventions
CO3 Understand climate finance instruments
CO4 Evaluate policy effectiveness
CO5 Apply economics to sustainability planning

Detailed Syllabus

Unit I: Environmental economics foundations; scarcity, efficiency, equity; externalities; public goods; valuation concepts, sustainability context.

Unit II: Economic instruments; taxes, subsidies, permits; carbon pricing; market based mechanisms, efficiency outcomes.

Unit III: Cost benefit analysis; discounting; project appraisal; environmental valuation methods; decision support applications.

Unit IV: Climate finance; mitigation adaptation finance; green bonds; climate funds; investment flows, risk management.

Unit V: Policy and governance; international climate finance architecture; national strategies; private sector roles, sustainable development alignment.

Text Books

1. Tietenberg, T., & Lewis, L. (2018). *Environmental and natural resource economics* (11th ed.). Routledge.
2. Perman, R., et al. (2011). *Natural resource and environmental economics* (4th ed.). Pearson.
3. Stern, N. (2007). *The economics of climate change*. Cambridge University Press.
4. Field, B. C., & Field, M. K. (2017). *Environmental economics* (7th ed.). McGraw-Hill.
5. Bowen, A., et al. (2014). *Green growth*. Oxford University Press.

Reference Books

1. Hanley, N., Shogren, J., & White, B. (2013). *Environmental economics*. Palgrave.
2. OECD. (2015). *Aligning policies for a low carbon economy*. OECD.
3. World Bank. (2020). *State and trends of carbon pricing*. World Bank.
4. UNEP. (2021). *Global climate finance*. United Nations.
5. Gillingham, K., & Stock, J. H. (2018). *The cost of reducing greenhouse gas emissions*. Journal of Economic Perspectives.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Green Hydrogen / Waste-to-Energy Systems)
Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Provide specialized knowledge in emerging clean technologies
2. Understand hydrogen or waste to energy systems
3. Analyze conversion processes and performance
4. Evaluate sustainability and deployment challenges
5. Support technology selection skills

Course Outcomes
CO1 Explain principles of selected elective technology

CO2 Analyze system components and processes
CO3 Evaluate environmental benefits and impacts
CO4 Understand policy and market drivers
CO5 Apply knowledge to technology assessment

Detailed Syllabus

Unit I: Clean energy transition context; role of green hydrogen or waste to energy; system boundaries; sustainability drivers, policy landscape overview.

Unit II: Technology fundamentals; electrolysis processes or waste conversion methods; feedstock characteristics; efficiency parameters, operating conditions.

Unit III: System components; reactors, electrolyzers, gasifiers; balance of plant; integration challenges, safety considerations.

Unit IV: Utilization pathways; hydrogen applications or energy recovery options; grid transport integration; emissions reduction potential.

Unit V: Techno economic and environmental assessment; lifecycle impacts; cost drivers; scalability challenges, future prospects.

Text Books

1. Gupta, R. B. (2019). *Hydrogen fuel*. CRC Press.
2. Basu, P. (2018). *Waste to energy conversion technology*. CRC Press.
3. IEA. (2019). *The future of hydrogen*. IEA.
4. Arena, U. (2012). *Process and technological aspects of waste to energy*. Waste Management.
5. Dincer, I., & Acar, C. (2015). *Review and evaluation of hydrogen production*. Renewable and Sustainable Energy Reviews.

Reference Books

1. Momirlan, M., & Veziroglu, T. N. (2005). *The properties of hydrogen*. International Journal of Hydrogen Energy.
2. McKendry, P. (2002). *Energy production from biomass*. Bioresource Technology.
3. UNEP. (2020). *Waste to energy*. United Nations.
4. Ball, M., & Weeda, M. (2015). *Hydrogen economy*. International Journal of Hydrogen Energy.
5. IRENA. (2022). *Green hydrogen cost reduction*. IRENA.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project (Sustainability Assessment / Case Study)
Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply interdisciplinary sustainability knowledge
2. Conduct problem identification and literature review
3. Perform data collection and analysis
4. Develop technical reporting and presentation skills
5. Encourage independent and collaborative learning

Course Outcomes
CO1 Identify relevant sustainability problem
CO2 Apply appropriate analytical tools
CO3 Interpret results systematically
CO4 Prepare structured project documentation
CO5 Present findings effectively

Guidelines
Problem selection related to sustainability or climate systems; faculty supervision; defined objectives and methodology; data analysis and interpretation; preparation of project report; presentation and evaluation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VI

Course 1

Course Title: Climate Policy, Law & Governance
Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand climate governance frameworks and institutions
2. Examine international and national climate laws
3. Analyze policy instruments and compliance mechanisms
4. Interpret legal dimensions of climate action
5. Support informed participation in governance processes

Course Outcomes
CO1 Explain climate policy architectures and actors
CO2 Interpret international climate agreements
CO3 Analyze national climate laws and regulations
CO4 Evaluate policy instruments and enforcement
CO5 Relate governance to climate outcomes

Detailed Syllabus

Unit I: Climate governance foundations; multilevel governance; state nonstate actors; institutions and processes; principles of equity responsibility transparency; coordination mechanisms, policy coherence, accountability structures, sustainable development alignment, implementation challenges.

Unit II: International climate regime; UNFCCC architecture; Kyoto Protocol, Paris Agreement; nationally determined contributions; reporting review mechanisms; compliance procedures, global stocktake, differentiation principles, climate diplomacy context.

Unit III: National climate law; legislative frameworks; regulatory instruments; sectoral policies; mitigation adaptation integration; institutional arrangements, interministerial coordination, legal mandates, implementation pathways, judicial oversight.

Unit IV: Policy instruments; market based mechanisms; carbon pricing; standards subsidies; fiscal tools; effectiveness efficiency considerations, distributional impacts, political economy factors, stakeholder engagement approaches.

Unit V: Governance challenges; enforcement capacity; transparency accountability; climate litigation; public participation; data disclosure mechanisms, adaptive governance, policy learning, resilience oriented decision making.

Text Books

1. Bodansky, D., Brunnée, J., & Rajamani, L. (2017). *International climate change law*. Oxford University Press.
2. Gupta, J. (2014). *The history of global climate governance*. Cambridge University Press.
3. Dubash, N. K. (Ed.). (2019). *India in a warming world*. Oxford University Press.
4. Peel, J., & Osofsky, H. (2015). *Climate change litigation*. Cambridge University Press.
5. Meadowcroft, J., et al. (2019). *Governing the climate transition*. Cambridge University Press.

Reference Books

1. UNFCCC. (2015). *Paris Agreement*. United Nations.
2. IPCC. (2022). *AR6 synthesis report*. Cambridge University Press.
3. Gunningham, N. (2017). *Regulating environmental governance*. Edward Elgar.
4. Ostrom, E. (2010). *Polycentric governance*. Global Environmental Change.
5. OECD. (2020). *Climate governance*. OECD.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Life Cycle Assessment & Sustainability Metrics
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand life cycle thinking principles
2. Apply LCA methodology to products systems
3. Analyze sustainability indicators and metrics
4. Interpret environmental footprints
5. Support evidence based sustainability decisions

Course Outcomes
CO1 Explain LCA phases and standards
CO2 Perform inventory and impact assessment
CO3 Interpret footprint indicators

CO4 Compare alternatives using metrics
CO5 Apply results to decision contexts

Detailed Syllabus

Unit I: Life cycle thinking; cradle to grave boundaries; functional units; system expansion; ISO standards overview; attributional consequential approaches, data quality considerations, sustainability relevance.

Unit II: Goal and scope definition; inventory analysis; data collection; process mapping; allocation rules; databases tools overview, uncertainty sources, documentation practices.

Unit III: Impact assessment; midpoint endpoint categories; characterization factors; normalization weighting; carbon water land footprints, interpretation frameworks, tradeoff analysis.

Unit IV: Sustainability metrics; indicators dashboards; SDG linkage; material energy intensity; circularity metrics; benchmarking methods, reporting standards, decision support use.

Unit V: Applications and limitations; product policy design; eco labeling; comparative assertions; sensitivity analysis; improvement strategies, stakeholder communication, governance implications.

Text Books

1. Guinée, J. (Ed.). (2011). *Life cycle assessment: Past, present, future*. Springer.
2. ISO. (2006). *ISO 14040/44*. ISO.
3. Baumann, H., & Tillman, A. M. (2004). *The hitch hiker's guide to LCA*. Studentlitteratur.
4. Hauschild, M., Rosenbaum, R., & Olsen, S. (2018). *Life cycle assessment*. Springer.
5. Finnveden, G., et al. (2009). *Recent developments in LCA*. Journal of Environmental Management.

Reference Books

1. Wackernagel, M., & Rees, W. (1996). *Ecological footprint*. New Society.
2. Wiedmann, T., & Minx, J. (2008). *Carbon footprint*. Ecological Economics.
3. Ellen MacArthur Foundation. (2015). *Circularity indicators*. EMF.
4. UNEP. (2020). *Guidelines for LCA*. United Nations.
5. OECD. (2018). *Measuring distance to SDGs*. OECD.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Emerging Technologies for Climate Mitigation
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Survey emerging mitigation technologies
2. Analyze technology readiness and impacts
3. Evaluate integration challenges
4. Assess sustainability implications
5. Support technology informed decisions

Course Outcomes
CO1 Identify emerging mitigation options
CO2 Analyze operating principles
CO3 Evaluate readiness and scalability
CO4 Assess environmental impacts
CO5 Relate technologies to net zero pathways

Detailed Syllabus

Unit I: Mitigation landscape; technology readiness levels; innovation cycles; systems integration; policy drivers; investment trends, deployment barriers, sustainability context.

Unit II: Negative emissions technologies; direct air capture; bioenergy with CCS; enhanced weathering; performance metrics, risks uncertainties, governance considerations.

Unit III: Advanced energy technologies; next generation photovoltaics; advanced batteries; power electronics; efficiency gains, materials constraints, lifecycle impacts.

Unit IV: Digital enablers; artificial intelligence; smart grids; demand response; optimization platforms; emissions monitoring verification, data driven mitigation.

Unit V: Assessment frameworks; techno economic analysis; lifecycle impacts; co benefits tradeoffs; scaling pathways, ethical considerations, transition planning.

Text Books

1. IEA. (2023). *Net zero roadmap*. IEA.
2. Nemet, G. (2019). *How solar energy became cheap*. Routledge.
3. Creutzig, F., et al. (2019). *Demand side solutions*. Nature Climate Change.
4. Keith, D. (2013). *A case for climate engineering*. MIT Press.
5. Vaclav Smil. (2017). *Energy and civilization*. MIT Press.

Reference Books

1. Royal Society. (2018). *Greenhouse gas removal*. Royal Society.
2. IPCC. (2022). *AR6 mitigation*. Cambridge University Press.
3. IRENA. (2022). *Innovation outlook*. IRENA.
4. OECD. (2021). *Digitalization and climate*. OECD.
5. UNEP. (2021). *Emissions gap report*. United Nations.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (Disaster Management / Blue Economy)
Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce disaster risk or blue economy concepts
2. Analyze hazard vulnerability or ocean systems
3. Evaluate management frameworks
4. Understand policy and governance aspects
5. Support sustainable development planning

Course Outcomes
CO1 Explain elective domain fundamentals
CO2 Analyze risks or marine resources
CO3 Evaluate management strategies
CO4 Interpret policy frameworks
CO5 Apply sustainability principles

Detailed Syllabus

Unit I: Foundations; disaster risk concepts or blue economy scope; drivers challenges; sustainability linkages, governance overview, stakeholder roles.

Unit II: Risk assessment or ocean systems; hazards exposure vulnerability or marine ecosystems; data indicators, monitoring approaches.

Unit III: Management strategies; preparedness mitigation response recovery or marine planning; conservation utilization balance, operational frameworks.

Unit IV: Technology tools; early warning systems or ocean observation; data platforms, decision support, capacity building.

Unit V: Policy and case studies; national international frameworks; financing mechanisms; community participation, sustainable outcomes.

Text Books

1. Coppola, D. (2015). *Introduction to disaster management*. Butterworth-Heinemann.
2. World Bank. (2017). *Blue economy*. World Bank.
3. UNDRR. (2019). *Global assessment report*. United Nations.
4. OECD. (2016). *The ocean economy*. OECD.
5. UNEP. (2020). *Ecosystem based management*. United Nations.

Reference Books

1. ISDR. (2015). *Sendai framework*. United Nations.
2. FAO. (2018). *Blue growth*. FAO.
3. Hallegatte, S. (2014). *Natural disasters and climate change*. World Bank.
4. Barbier, E. (2017). *The blue economy*. Routledge.
5. UNDP. (2020). *Risk informed development*. United Nations.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project (Industry / Research Based)
Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Solve complex climate sustainability problem
2. Apply advanced analytical methods
3. Integrate interdisciplinary knowledge
4. Produce professional documentation
5. Demonstrate independent research capability

Course Outcomes
CO1 Define problem and objectives clearly
CO2 Apply appropriate methodology and tools
CO3 Analyze results rigorously
CO4 Prepare comprehensive project report
CO5 Defend work effectively

Guidelines
Industry or research oriented problem; proposal approval; systematic literature review; data collection analysis; progress reviews; final report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

Seminar / Viva-Voce
Course Category: Project Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical communication skills
2. Critically review contemporary topics
3. Synthesize literature and findings
4. Improve presentation competence
5. Prepare for professional evaluation

Course Outcomes
CO1 Select relevant seminar topic
CO2 Conduct structured literature review
CO3 Present content coherently
CO4 Respond to technical queries
CO5 Demonstrate professional articulation

Guidelines
Topic selection aligned to program; seminar report submission; oral presentation; viva voce examination by panel.

Evaluation Scheme
Continuous Assessment (100%)

B.Tech. – Quantum Computing

Duration: 4 Years | 8 SEMESTER s | Total Credits: 160

SEMESTER I

Mathematics I (Calculus and Linear Algebra)

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Develop strong foundations in calculus concepts relevant to engineering systems
2. Build analytical skills for limits, continuity, and differentiation techniques
3. Apply integral calculus to area, volume, and engineering applications
4. Introduce vector spaces and matrices for engineering problem solving
5. Enable mathematical modeling of physical and computational systems

Course Outcomes
CO1: Apply limits, continuity, and differentiation to engineering problems
CO2: Use differential calculus for optimization and curve analysis
CO3: Apply integral calculus to physical and engineering models
CO4: Solve systems using matrices and determinants
CO5: Use vector spaces and eigen concepts in engineering contexts

Detailed Syllabus

Unit I
Functions, limits, continuity; standard limit evaluation, algebraic manipulation; continuity conditions, piecewise functions; elementary transcendental functions; graphical interpretation; engineering relevance; mathematical rigor; symbolic representation; approximation concepts; foundational calculus framework for engineering analysis and modeling.

Unit II
Differentiation techniques, implicit differentiation, higher order derivatives; physical interpretation of derivatives; maxima, minima, curvature; optimization problems; rate of change; engineering design applications; sensitivity analysis; mathematical formulation of practical engineering systems and constraints.

Unit III
Integral calculus, definite and indefinite integrals; standard methods, substitution, partial fractions; applications to area, volume, work; physical interpretation; engineering system modeling; accumulation functions; computational relevance; problem solving strategies for applied engineering contexts.

Unit IV
Matrices, matrix operations; determinants, properties; inverse of matrices; solution of linear equations; rank; consistency of systems; engineering applications; computational efficiency; representation of multi variable engineering systems using linear algebraic frameworks.

Unit V
Vector spaces, linear independence, basis, dimension; eigenvalues and eigenvectors; diagonalization; applications in engineering systems; stability analysis; transformation concepts; mathematical abstraction supporting advanced engineering and quantum computation foundations.

Text Books

1. Thomas, G. B., Weir, M. D., & Hass, J. (2020). *Thomas' calculus* (14th ed.). Pearson Education.
2. Anton, H., Bivens, I., & Davis, S. (2019). *Calculus* (11th ed.). Wiley.
3. Lay, D. C., Lay, S. R., & McDonald, J. J. (2021). *Linear algebra and its applications* (6th ed.). Pearson.
4. Stewart, J. (2018). *Calculus: Early transcendentals* (8th ed.). Cengage Learning.
5. Strang, G. (2019). *Introduction to linear algebra* (5th ed.). Wellesley Cambridge Press.

Reference Books

1. Kreyszig, E. (2017). *Advanced engineering mathematics* (10th ed.). Wiley.
2. Erwin, K. (2016). *Applied mathematics for engineers*. Springer.
3. Lipschutz, S., & Lipson, M. (2018). *Linear algebra* (4th ed.). McGraw-Hill.
4. Zill, D. G. (2018). *Calculus with applications* (10th ed.). Jones & Bartlett.
5. Boylestad, R. (2019). *Mathematical methods for engineers*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Physics I (Classical Mechanics and Waves)

Course Category
Engineering Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Strengthen understanding of classical mechanics principles
2. Apply Newtonian mechanics to engineering systems
3. Introduce oscillations and wave motion fundamentals
4. Relate physical laws to technological applications
5. Prepare foundation for modern and quantum physics

Course Outcomes
CO1: Apply mechanics laws to engineering problems
CO2: Analyze motion using energy and momentum concepts
CO3: Evaluate oscillatory systems and resonance
CO4: Understand wave propagation characteristics
CO5: Correlate physical principles with engineering applications

Detailed Syllabus

Unit I
Units, dimensions, vectors; Newton's laws of motion; inertial and non inertial frames; friction; engineering applications; free body diagrams; equilibrium analysis; mathematical modeling of mechanical systems and engineering structures.

Unit II
Work, energy, power; conservative and non conservative forces; potential energy; momentum, impulse; collisions; center of mass; angular momentum; rigid body dynamics; engineering relevance in mechanical and structural systems.

Unit III
Simple harmonic motion; oscillatory systems; damped and forced oscillations; resonance; quality factor; energy transfer; mechanical vibrations; engineering applications in machines, structures, and signal systems.

Unit IV
Wave motion; transverse and longitudinal waves; wave equation; superposition; standing waves; boundary conditions; engineering relevance; vibration analysis; acoustical systems; wave based engineering applications.

Unit V
Sound waves; acoustics; intensity; Doppler effect; ultrasonic waves; applications in

engineering and industry; non destructive testing; medical diagnostics; signal transmission fundamentals supporting advanced technological systems.

Text Books

1. Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.
2. Serway, R. A., & Jewett, J. W. (2019). *Physics for scientists and engineers* (10th ed.). Cengage Learning.
3. Tipler, P. A., & Mosca, G. (2020). *Physics for scientists and engineers* (6th ed.). W. H. Freeman.
4. Young, H. D., & Freedman, R. A. (2019). *University physics with modern physics* (15th ed.). Pearson.
5. Verma, H. C. (2017). *Concepts of physics, Volume I* (2nd ed.). Bharati Bhawan.

Reference Books

1. Kleppner, D., & Kolenkow, R. (2018). *An introduction to mechanics*. Cambridge University Press.
2. Feynman, R. P., Leighton, R. B., & Sands, M. (2017). *The Feynman lectures on physics, Vol. I*. Basic Books.
3. Marion, J. B., & Thornton, S. T. (2019). *Classical dynamics of particles and systems* (5th ed.). Cengage.
4. Resnick, R. (2016). *Introduction to special relativity*. Wiley.
5. French, A. P. (2018). *Newtonian mechanics*. Norton.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Chemistry / Environmental Science

Course Category
Basic Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand chemical principles relevant to engineering materials
2. Introduce environmental sustainability concepts
3. Relate chemistry to industrial and technological applications

4. Promote awareness of environmental protection
5. Develop responsible engineering perspectives

Course Outcomes
CO1: Apply chemistry principles to engineering materials
CO2: Understand water and energy resources
CO3: Analyze environmental pollution issues
CO4: Recognize sustainable engineering practices
CO5: Apply environmental regulations in engineering context

Detailed Syllabus

Unit I
Atomic structure; chemical bonding; molecular interactions; periodic properties; material relevance; engineering applications; structure property relationships; foundational chemistry concepts supporting engineering materials and technological systems.

Unit II
Water chemistry; hardness; purification methods; desalination; industrial water treatment; corrosion principles; prevention methods; material protection; engineering relevance in infrastructure and industrial systems.

Unit III
Fuels and combustion; calorific value; conventional and renewable energy sources; batteries; fuel cells; electrochemistry; engineering applications; sustainable energy perspectives for modern technological systems.

Unit IV
Environmental pollution; air, water, soil pollution; sources and effects; control measures; waste management; environmental impact assessment; engineering responsibility; sustainable development frameworks.

Unit V
Environmental laws; standards; ethics; climate change; global warming; biodiversity; resource conservation; role of engineers; policy awareness; integration of environmental considerations in engineering design.

Text Books

1. Jain, P. C., & Jain, M. (2019). *Engineering chemistry* (17th ed.). Dhanpat Rai.
2. Dara, S. S., & Mishra, D. D. (2018). *A textbook of engineering chemistry*. S. Chand.
3. Peavy, H. S., & Row, R. G. (2017). *Environmental engineering*. McGraw-Hill.
4. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2019). *Chemistry for environmental engineering*. McGraw-Hill.

5. Masters, G. M., & Ela, W. P. (2018). *Introduction to environmental engineering and science*. Pearson.

Reference Books

1. Manahan, S. E. (2017). *Environmental chemistry*. CRC Press.
2. Baird, C., & Cann, M. (2018). *Environmental chemistry*. W. H. Freeman.
3. Raghavan, V. (2016). *Environmental studies*. Oxford University Press.
4. Sharma, B. K. (2019). *Industrial chemistry*. Krishna Prakashan.
5. De, A. K. (2018). *Environmental chemistry*. New Age International.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Introduction to Programming (C / Python)

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop logical thinking and algorithmic skills
2. Introduce structured programming concepts
3. Apply programming constructs to problem solving
4. Familiarize with C or Python syntax
5. Prepare foundation for advanced computing courses

Course Outcomes
CO1: Design basic algorithms for problem solving
CO2: Implement programs using control structures
CO3: Use arrays and functions effectively
CO4: Apply programming to engineering problems
CO5: Develop debugging and testing skills

Detailed Syllabus

Unit I
Problem solving concepts; algorithms; flowcharts; programming paradigms; basics of C or Python; program structure; compilation or interpretation; logical thinking; foundational computing skills for engineering applications.

Unit II
Data types; variables; operators; expressions; input output statements; precedence; type conversion; programming logic; numerical computation; engineering oriented problem solving using structured programming constructs.

Unit III
Control structures; conditional statements; looping constructs; nested logic; program flow control; efficiency considerations; computational thinking; application in iterative engineering calculations and simulations.

Unit IV
Arrays; strings; functions; parameter passing; scope; modular programming; code reusability; structured program design; engineering applications requiring data organization and functional abstraction.

Unit V
Basic pointers or references; simple file handling; error handling; debugging techniques; program testing; documentation practices; introduction to libraries; preparation for advanced programming and computational courses.

Text Books

1. Kernighan, B. W., & Ritchie, D. M. (2018). *The C programming language* (2nd ed.). Pearson.
2. Reema Thareja. (2019). *Programming in C*. Oxford University Press.
3. Downey, A. B. (2020). *Think Python* (2nd ed.). O'Reilly Media.
4. Zelle, J. (2017). *Python programming*. Franklin Beedle.
5. Kanetkar, Y. (2018). *Let us C*. BPB Publications.

Reference Books

1. Deitel, P., & Deitel, H. (2017). *C how to program*. Pearson.
2. Lutz, M. (2019). *Learning Python*. O'Reilly Media.
3. McGrath, M. (2018). *Python in easy steps*. In Easy Steps.
4. Schildt, H. (2017). *C complete reference*. McGraw-Hill.
5. Guttag, J. V. (2021). *Introduction to computation and programming using Python*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Basics of Electrical and Electronics Engineering

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce electrical and electronic fundamentals
2. Understand basic circuit laws and components
3. Familiarize with AC and DC systems
4. Introduce electronic devices and applications
5. Build foundation for advanced electronics courses

Course Outcomes
CO1: Apply electrical laws to simple circuits
CO2: Analyze DC and AC circuits
CO3: Understand basic electronic components
CO4: Identify applications of electrical machines
CO5: Apply fundamentals in engineering practice

Detailed Syllabus

Unit I
Electrical quantities; voltage, current, resistance; Ohm's law; Kirchhoff's laws; series and parallel circuits; power concepts; measurement units; engineering relevance; basic circuit analysis foundations.

Unit II
DC circuits; network theorems; batteries; energy storage; transient response; practical circuit analysis; engineering applications; fundamentals supporting electrical and electronic system design.

Unit III
AC circuits; sinusoidal waveforms; impedance; phasors; resonance; power factor; three phase systems; engineering applications; electrical energy utilization and efficiency considerations.

Unit IV
Electronic components; diodes; transistors; rectifiers; amplifiers; switching concepts; basic electronic circuits; engineering relevance; introduction to electronic system building blocks.

Unit V
Electrical machines; transformers; motors; generators; basic operating principles; applications; safety considerations; industrial relevance; foundational understanding for electromechanical systems.

Text Books

1. Hughes, E. (2019). *Electrical and electronic technology* (12th ed.). Pearson.
2. Theraja, B. L., & Theraja, A. K. (2018). *A textbook of electrical technology*. S. Chand.
3. Boylestad, R. L., & Nashelsky, L. (2017). *Electronic devices and circuit theory*. Pearson.
4. Fitzgerald, A. E., Kingsley, C., & Umans, S. (2018). *Electric machinery*. McGraw-Hill.
5. Bird, J. (2017). *Electrical circuit theory and technology*. Routledge.

Reference Books

1. Alexander, C. K., & Sadiku, M. N. O. (2019). *Fundamentals of electric circuits*. McGraw-Hill.
2. Floyd, T. L. (2018). *Electronic devices*. Pearson.
3. Gonen, T. (2017). *Electric power distribution engineering*. CRC Press.
4. Sen, P. C. (2016). *Principles of electric machines*. Wiley.
5. Edminister, J. A. (2018). *Electric circuits*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Communication Skills and Professional English

Course Category
Humanities and Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Enhance technical communication skills
2. Develop professional English proficiency
3. Improve presentation and interpersonal skills
4. Strengthen reading and writing abilities
5. Prepare students for professional environments

Course Outcomes
CO1: Communicate effectively in professional contexts
CO2: Apply technical writing skills

CO3: Demonstrate presentation competence
CO4: Use appropriate professional vocabulary
CO5: Exhibit interpersonal communication skills

Detailed Syllabus

Unit I
Communication process; verbal and non verbal communication; barriers; listening skills; professional contexts; technical communication relevance; interpersonal effectiveness; foundational concepts for engineering communication competence.

Unit II
Grammar review; vocabulary building; sentence structure; technical terminology; clarity and precision; professional usage; written communication foundations supporting engineering documentation and reporting.

Unit III
Reading comprehension; technical texts; note making; summarization; analytical reading; interpretation skills; academic and professional relevance; information processing for engineering studies.

Unit IV
Technical writing; emails; reports; proposals; resumes; documentation standards; professional formats; clarity; coherence; engineering communication practices and workplace relevance.

Unit V
Oral presentation skills; group discussion; interviews; professional etiquette; confidence building; teamwork communication; workplace interaction skills; preparation for industry and professional environments.

Text Books

1. Meenakshi Raman, & Sharma, S. (2018). *Technical communication*. Oxford University Press.
2. Bovee, C. L., & Thill, J. V. (2019). *Business communication today*. Pearson.
3. Murphy, R. (2016). *English grammar in use*. Cambridge University Press.
4. Hewings, M. (2017). *Advanced grammar in use*. Cambridge University Press.
5. Guffey, M. E., & Loewy, D. (2018). *Essentials of business communication*. Cengage.

Reference Books

1. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2019). *Business communication*. McGraw-Hill.
2. Eastwood, J. (2016). *Oxford guide to English grammar*. Oxford University Press.
3. Jain, P. (2017). *Professional communication*. McGraw-Hill.

4. McCarthy, M., & O'Dell, F. (2017). *English vocabulary in use*. Cambridge University Press.
5. Powell, M. (2019). *Presenting in English*. Heinle.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Graphics / Workshop Practice

Course Category
Engineering Science Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Develop visualization and drafting skills
2. Understand basic engineering drawing conventions
3. Introduce workshop tools and practices
4. Enhance spatial imagination abilities
5. Promote safety and precision in practice

Course Outcomes
CO1: Interpret engineering drawings correctly
CO2: Apply drawing standards and conventions
CO3: Use basic workshop tools safely
CO4: Develop hands on technical skills
CO5: Demonstrate spatial visualization competence

List of Experiments / Exercises

1. Practice of freehand sketching of engineering components using drawing instruments, focusing on proportion, line quality, and basic visualization skills relevant to engineering documentation.
2. Construction of orthographic projections of points and lines using BIS standards, including scaling methods, dimensioning techniques, and interpretation of multiview drawings.
3. Drawing of projections of planes and solids in different orientations, emphasizing true shape visualization, spatial reasoning, and engineering drawing accuracy.
4. Development of isometric views from orthographic projections, applying conversion techniques, proportion maintenance, and three dimensional visualization skills.

5. Introduction to basic workshop tools and safety practices, including identification, handling techniques, and preventive safety measures for engineering workshops.
6. Measurement practices using vernier calipers and micrometers, focusing on accuracy, least count calculation, and practical engineering measurement skills.
7. Simple fitting operations such as filing and drilling, emphasizing dimensional accuracy, tool handling, and workshop discipline.
8. Demonstration of carpentry tools and basic joints, including material handling, tool usage, and understanding of structural joints.
9. Sheet metal operations such as marking, cutting, and bending, focusing on fabrication basics and safety considerations.
10. Demonstration of welding or soldering processes, understanding equipment, joint preparation, and safety precautions in joining operations.

Expected Outcomes
Development of basic drawing competence, workshop discipline, safety awareness, and hands on engineering skills supporting core engineering education.

Evaluation Scheme
Continuous Assessment (60%) + End-SEMESTER Practical Examination (40%)

SEMESTER II

Mathematics II (Probability and Statistics)

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Build foundational understanding of probability concepts and random phenomena
2. Develop analytical skills in discrete and continuous random variables
3. Apply statistical methods to engineering data analysis
4. Introduce correlation, regression, and hypothesis testing concepts
5. Enable probabilistic modeling for engineering and computational systems

Course Outcomes
CO1: Apply probability laws to engineering problems
CO2: Analyze discrete and continuous random variables
CO3: Compute statistical measures for data interpretation
CO4: Apply correlation and regression techniques
CO5: Use probability distributions in engineering contexts

Detailed Syllabus

Unit I
Probability concepts; sample space, events; axioms of probability; addition and multiplication theorems; conditional probability; Bayes theorem; engineering applications; uncertainty modeling; probabilistic reasoning frameworks for engineering decision making.

Unit II
Random variables; discrete and continuous types; probability mass and density functions; distribution functions; expectation; variance; higher moments; engineering interpretations; stochastic representation of engineering and computational systems.

Unit III
Discrete probability distributions; binomial, Poisson, geometric distributions; mean and variance; applications in engineering quality control; communication systems; reliability analysis; modeling of discrete engineering processes.

Unit IV
Continuous probability distributions; uniform, exponential, normal distributions; properties;

standard normal variable; applications in noise analysis; tolerance design; reliability studies; engineering data modeling using continuous distributions.

Unit V
Statistics; measures of central tendency and dispersion; correlation; regression analysis; hypothesis testing; confidence intervals; engineering data interpretation; decision making under uncertainty; statistical foundations for experimental analysis.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and statistics for engineers and scientists* (9th ed.). Pearson.
2. Ross, S. M. (2019). *Introduction to probability models* (12th ed.). Academic Press.
3. Devore, J. L. (2018). *Probability and statistics for engineering and the sciences* (9th ed.). Cengage Learning.
4. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2019). *Probability and statistical inference* (10th ed.). Pearson.
5. Montgomery, D. C., & Runger, G. C. (2018). *Applied statistics and probability for engineers* (7th ed.). Wiley.

Reference Books

1. Johnson, R. A., Miller, I., & Freund, J. E. (2017). *Probability and statistics for engineers*. Pearson.
2. Papoulis, A., & Pillai, S. U. (2018). *Probability, random variables, and stochastic processes*. McGraw-Hill.
3. Spiegel, M. R., Schiller, J., & Srinivasan, R. (2019). *Probability and statistics*. McGraw-Hill.
4. Box, G. E. P., Hunter, J. S., & Hunter, W. G. (2018). *Statistics for experimenters*. Wiley.
5. Mood, A. M., Graybill, F. A., & Boes, D. C. (2017). *Introduction to the theory of statistics*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Engineering Physics II (Modern Physics)

Course Category
Engineering Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Introduce concepts of modern physics relevant to engineering
2. Understand quantum and relativistic phenomena
3. Apply solid state physics concepts to electronic materials
4. Develop foundations for quantum technologies
5. Relate physical principles to advanced engineering systems

Course Outcomes
CO1: Explain quantum and relativistic concepts
CO2: Apply wave particle duality principles
CO3: Analyze crystal structures and properties
CO4: Understand semiconductor physics basics
CO5: Correlate modern physics with engineering applications

Detailed Syllabus

Unit I
Planck's hypothesis; black body radiation; photoelectric effect; Compton effect; wave particle duality; de Broglie wavelength; experimental evidences; quantum concepts forming foundations for modern engineering and quantum technologies.

Unit II
Schrodinger wave equation; physical interpretation; particle in a box; potential step and barrier; tunneling effect; expectation values; mathematical formalism supporting quantum behavior in engineering systems.

Unit III
Atomic structure; hydrogen atom; energy levels; quantum numbers; spectra; selection rules; engineering relevance; atomic models supporting material science and quantum device understanding.

Unit IV
Solid state physics; crystal structures; lattice planes; Miller indices; X ray diffraction; Bragg's law; engineering materials characterization; structural analysis of solids for electronic applications.

Unit V
Semiconductors; intrinsic and extrinsic types; energy bands; carrier concentration;

conductivity; PN junction concepts; applications in electronic devices; foundation for semiconductor and quantum hardware technologies.

Text Books

1. Beiser, A. (2017). *Concepts of modern physics* (6th ed.). McGraw-Hill.
2. Eisberg, R., & Resnick, R. (2018). *Quantum physics of atoms, molecules, solids*. Wiley.
3. Kittel, C. (2019). *Introduction to solid state physics* (8th ed.). Wiley.
4. Ghatak, A., & Lokanathan, S. (2018). *Quantum mechanics*. McMillan.
5. Singh, J. (2016). *Semiconductor devices*. Wiley.

Reference Books

1. Liboff, R. L. (2018). *Introductory quantum mechanics*. Pearson.
2. Griffiths, D. J., & Schroeter, D. (2018). *Introduction to quantum mechanics*. Cambridge University Press.
3. Sze, S. M., & Ng, K. K. (2017). *Physics of semiconductor devices*. Wiley.
4. Ashcroft, N. W., & Mermin, N. D. (2019). *Solid state physics*. Cengage.
5. Tipler, P. A., & Llewellyn, R. A. (2018). *Modern physics*. Freeman.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Electronics and Logic Design

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce digital logic concepts and number systems
2. Develop skills in Boolean algebra and logic simplification
3. Understand combinational and sequential circuits
4. Familiarize with digital components and ICs
5. Prepare foundation for computer and quantum hardware systems

Course Outcomes
CO1: Convert and manipulate number systems
CO2: Simplify Boolean expressions
CO3: Design combinational logic circuits
CO4: Analyze sequential logic systems
CO5: Apply digital logic in engineering applications

Detailed Syllabus

Unit I
Number systems; binary, octal, hexadecimal; conversions; binary arithmetic; complements; codes; digital representation of data; engineering relevance; foundational digital concepts for computing systems.

Unit II
Boolean algebra; logic gates; theorems; simplification techniques; Karnaugh maps; minimization methods; engineering applications; logical optimization of digital systems and circuits.

Unit III
Combinational logic circuits; adders; subtractors; multiplexers; demultiplexers; encoders; decoders; design procedures; practical relevance in digital computing architectures.

Unit IV
Sequential logic circuits; latches; flip flops; registers; counters; timing diagrams; clocking concepts; engineering applications; state representation and control in digital systems.

Unit V
Digital integrated circuits; logic families; characteristics; memory devices; introduction to programmable logic devices; applications; relevance to modern digital and quantum computing hardware.

Text Books

1. Morris Mano, M., & Ciletti, M. (2017). *Digital design* (6th ed.). Pearson.
2. Floyd, T. L. (2018). *Digital fundamentals* (11th ed.). Pearson.
3. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2017). *Digital systems*. Pearson.
4. Roth, C. H., & Kinney, L. L. (2019). *Fundamentals of logic design*. Cengage.
5. Wakerly, J. F. (2018). *Digital design principles and practices*. Pearson.

Reference Books

1. Katz, R. H., & Borriello, G. (2016). *Contemporary logic design*. Pearson.
2. Salivahanan, S., Kumar, S. S., & Vallavaraj, A. (2018). *Digital circuits and design*. Oxford.

3. Hill, F. J., & Peterson, G. R. (2017). *Digital systems*. Wiley.
4. Brown, S., & Vranesic, Z. (2019). *Fundamentals of digital logic*. McGraw-Hill.
5. Biswas, N. N. (2016). *Logic design theory*. Prentice Hall.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Object-Oriented Programming

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce object oriented programming concepts
2. Develop modular and reusable code structures
3. Apply classes and objects in program design
4. Understand inheritance and polymorphism
5. Prepare for advanced software and quantum programming

Course Outcomes
CO1: Apply object oriented programming principles
CO2: Design programs using classes and objects
CO3: Implement inheritance and polymorphism
CO4: Handle exceptions and files
CO5: Develop structured and maintainable programs

Detailed Syllabus

Unit I
Programming paradigms; object oriented concepts; classes and objects; data abstraction; encapsulation; program structure; engineering relevance; foundation for scalable software system development.

Unit II
Constructors; destructors; member functions; access specifiers; object creation; memory concepts; program design considerations; structured development for engineering applications.

Unit III
Inheritance; types; method overriding; polymorphism; dynamic binding; code reuse; hierarchical modeling; engineering software design efficiency and extensibility.

Unit IV
Operator overloading; templates or generics; exception handling; robustness; error management; engineering software reliability; structured handling of runtime anomalies.

Unit V
File handling; input output streams; basic data persistence; standard libraries; introduction to graphical or numerical libraries; preparation for advanced computing and application development.

Text Books

1. Stroustrup, B. (2018). *The C++ programming language* (4th ed.). Addison-Wesley.
2. Deitel, P., & Deitel, H. (2017). *C++ how to program*. Pearson.
3. Balagurusamy, E. (2019). *Object oriented programming with C++*. McGraw-Hill.
4. Horstmann, C. S. (2018). *Core Java volume I*. Pearson.
5. Schildt, H. (2017). *Java: The complete reference*. McGraw-Hill.

Reference Books

1. Booch, G. (2016). *Object oriented analysis and design*. Pearson.
2. Meyer, B. (2018). *Object oriented software construction*. Pearson.
3. Lafore, R. (2017). *Object oriented programming in C++*. SAMS.
4. Sierra, K., & Bates, B. (2018). *Head first Java*. O'Reilly.
5. Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (2019). *Design patterns*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Data Structures and Algorithms

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamental data structures

2. Develop algorithmic problem solving skills
3. Analyze algorithm efficiency
4. Apply data structures to engineering problems
5. Prepare for advanced computing and quantum algorithms

Course Outcomes
CO1: Implement basic data structures
CO2: Analyze algorithm complexity
CO3: Apply searching and sorting techniques
CO4: Use trees and graphs effectively
CO5: Solve engineering problems using algorithms

Detailed Syllabus

Unit I
Introduction to data structures; abstract data types; arrays; stacks; queues; operations; applications; memory representation; foundational concepts supporting efficient engineering computations.

Unit II
Linked lists; singly, doubly, circular types; operations; dynamic memory allocation; applications; engineering relevance; data organization for flexible computational systems.

Unit III
Searching techniques; linear and binary search; sorting algorithms; bubble, selection, insertion, merge, quick sorts; complexity analysis; engineering performance considerations.

Unit IV
Trees; binary trees; traversals; binary search trees; heaps; priority queues; applications; hierarchical data modeling; engineering system organization.

Unit V
Graphs; representations; traversal algorithms; shortest path; spanning trees; applications; engineering networks; algorithmic modeling of complex interconnected systems.

Text Books

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). *Introduction to algorithms* (4th ed.). MIT Press.
2. Weiss, M. A. (2018). *Data structures and algorithm analysis*. Pearson.
3. Horowitz, E., Sahni, S., & Rajasekaran, S. (2018). *Computer algorithms*. Galgotia.
4. Goodrich, M. T., Tamassia, R., & Goldwasser, M. (2019). *Data structures and algorithms in Java*. Wiley.
5. Lafore, R. (2017). *Data structures and algorithms in Java*. SAMS.

Reference Books

1. Sahni, S. (2018). *Data structures, algorithms, and applications*. McGraw-Hill.
2. Sedgewick, R., & Wayne, K. (2019). *Algorithms*. Addison-Wesley.
3. Kleinberg, J., & Tardos, E. (2017). *Algorithm design*. Pearson.
4. Aho, A. V., Hopcroft, J. E., & Ullman, J. D. (2018). *Data structures and algorithms*. Pearson.
5. Skiena, S. S. (2020). *The algorithm design manual*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Design Thinking and Innovation

Course Category
Humanities and Management Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce design thinking principles
2. Develop creative problem solving skills
3. Apply innovation frameworks to engineering problems
4. Encourage user centric design approaches
5. Promote entrepreneurial mindset

Course Outcomes
CO1: Apply design thinking methodologies
CO2: Identify user needs effectively
CO3: Generate innovative solutions
CO4: Prototype engineering ideas
CO5: Demonstrate collaborative problem solving

Detailed Syllabus

Unit I
Design thinking concepts; creativity; innovation; human centered design; problem identification; engineering relevance; structured approaches to creative engineering problem solving.

Unit II
Empathy mapping; user research; need analysis; stakeholder perspectives; observation techniques; engineering context; understanding user driven engineering challenges.

Unit III
Ideation techniques; brainstorming; mind mapping; concept generation; evaluation methods; feasibility analysis; innovation in engineering design processes.

Unit IV
Prototyping; low fidelity models; rapid prototyping; testing methods; iteration; engineering product development; validation of design solutions.

Unit V
Innovation ecosystems; entrepreneurship basics; intellectual property awareness; commercialization; teamwork; ethics; translating engineering ideas into viable solutions.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.
2. Liedtka, J., & Ogilvie, T. (2018). *Designing for growth*. Columbia University Press.
3. Kelley, T., & Kelley, D. (2017). *Creative confidence*. Crown.
4. Osterwalder, A., & Pigneur, Y. (2019). *Business model generation*. Wiley.
5. Tidd, J., & Bessant, J. (2020). *Managing innovation*. Wiley.

Reference Books

1. Cross, N. (2018). *Engineering design methods*. Wiley.
2. Kumar, V. (2017). *101 design methods*. Wiley.
3. IDEO. (2015). *The field guide to human centered design*. IDEO.
4. Ulrich, K. T., & Eppinger, S. D. (2019). *Product design and development*. McGraw-Hill.
5. Drucker, P. F. (2018). *Innovation and entrepreneurship*. Harper.

Evaluation Scheme
Continuous Assessment (100%)

Internship / Industrial Orientation

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industrial environments
2. Understand professional practices and ethics
3. Observe engineering workflows and safety practices
4. Relate academic knowledge to industry applications
5. Develop professional attitude and discipline

Course Outcomes
CO1: Demonstrate awareness of industrial practices
CO2: Relate theory to real world engineering
CO3: Observe professional and ethical standards
CO4: Develop workplace communication skills
CO5: Prepare basic industrial exposure reports

Guidelines
Industrial visits; expert lectures; basic hands on exposure; report preparation; institutional supervision; industry interaction documentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER

Engineering Mathematics III (Complex Analysis and Transforms)

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Develop understanding of complex variable theory for engineering analysis
2. Apply complex functions and mappings in engineering problems
3. Introduce Laplace and Fourier transforms for system analysis
4. Solve differential equations using transform techniques
5. Build mathematical foundations for signals, systems, and quantum studies

Course Outcomes
CO1: Apply complex number concepts and functions
CO2: Analyze analytic functions and mappings
CO3: Use complex integration techniques
CO4: Apply Laplace transforms to differential equations
CO5: Use Fourier transforms in engineering applications

Detailed Syllabus

Unit I
Complex numbers; algebraic operations; polar and exponential forms; elementary functions; limits and continuity; differentiability; analytic functions; Cauchy Riemann equations; harmonic functions; foundational complex variable concepts for engineering analysis.

Unit II
Complex integration; line integrals; Cauchy integral theorem; Cauchy integral formula; Taylor series; Laurent series; singularities; residues; residue theorem; evaluation of real integrals using complex analysis methods.

Unit III
Conformal mapping; elementary transformations; bilinear transformations; preservation of angles; mapping of regions; applications in engineering fields; flow visualization; transformation based problem solving in physical and engineering systems.

Unit IV
Laplace transforms; definition; existence conditions; properties; transforms of standard

functions; inverse Laplace transforms; convolution theorem; solution of ordinary differential equations arising in engineering systems.

Unit V
Fourier series; trigonometric and exponential forms; Fourier transforms; properties; applications in signal analysis; frequency domain representation; engineering relevance; foundations for systems, communication, and quantum signal processing.

Text Books

1. Kreyszig, E. (2017). *Advanced engineering mathematics* (10th ed.). Wiley.
2. Churchill, R. V., & Brown, J. W. (2018). *Complex variables and applications* (9th ed.). McGraw-Hill.
3. Erwin, K. (2016). *Advanced engineering mathematics*. Wiley.
4. Zill, D. G., & Cullen, M. R. (2018). *Advanced engineering mathematics*. Jones & Bartlett.
5. Bansal, R. (2019). *Engineering mathematics*. Laxmi Publications.

Reference Books

1. Brown, J. W., & Churchill, R. V. (2019). *Complex variables and applications*. McGraw-Hill.
2. Spiegel, M. R., Lipschutz, S., & Liu, J. (2018). *Complex variables*. McGraw-Hill.
3. Debnath, L., & Bhatta, D. (2017). *Integral transforms and their applications*. CRC Press.
4. Tolstov, G. P. (2018). *Fourier series*. Dover Publications.
5. Doetsch, G. (2019). *Introduction to the theory and application of the Laplace transformation*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Signals and Systems

Course Category
Engineering Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Introduce fundamental concepts of signals and systems
2. Analyze continuous and discrete time signals
3. Apply system modeling and representation techniques
4. Use transform methods for system analysis
5. Prepare foundations for communication and quantum signal processing

Course Outcomes
CO1: Classify and analyze signals
CO2: Model and analyze linear time invariant systems
CO3: Apply convolution techniques
CO4: Use Laplace and Fourier transforms in system analysis
CO5: Interpret system behavior in time and frequency domains

Detailed Syllabus

Unit I
Signal classification; continuous and discrete signals; deterministic and random signals; periodic and aperiodic signals; basic signal operations; time scaling and shifting; engineering relevance of signal representations.

Unit II
System concepts; continuous and discrete systems; linearity; time invariance; causality; stability; memory; interconnections of systems; block diagram representation; modeling of engineering systems.

Unit III
Linear time invariant systems; impulse response; convolution integral; convolution sum; properties; graphical interpretation; applications in engineering systems; response analysis of physical and computational systems.

Unit IV
Fourier series representation; properties; frequency spectra; Fourier transform; properties; energy and power signals; frequency domain analysis; engineering applications in communication and signal processing.

Unit V
Laplace transform; region of convergence; properties; system transfer functions; poles and zeros; system stability; time response analysis; relevance to control, communication, and quantum engineering systems.

Text Books

1. Oppenheim, A. V., Willsky, A. S., & Nawab, S. H. (2019). *Signals and systems* (2nd ed.). Pearson.
2. Lathi, B. P. (2018). *Linear systems and signals* (3rd ed.). Oxford University Press.
3. Haykin, S., & Van Veen, B. (2017). *Signals and systems*. Wiley.
4. Proakis, J. G., & Manolakis, D. G. (2018). *Digital signal processing*. Pearson.
5. Roberts, M. J. (2019). *Signals and systems*. McGraw-Hill.

Reference Books

1. Papoulis, A. (2018). *Signal analysis*. McGraw-Hill.
2. Mitra, S. K. (2017). *Signals and systems*. McGraw-Hill.
3. Simon Haykin. (2019). *Communication systems*. Wiley.
4. Couch, L. W. (2018). *Digital and analog communication systems*. Pearson.
5. Puri, M. C., & Singh, J. S. (2017). *Signals and systems*. Tata McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Computer Organization and Architecture

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand basic structure and functioning of computers
2. Analyze instruction execution and data representation
3. Study memory organization and hierarchy
4. Understand input output and peripheral interfacing concepts
5. Prepare foundations for advanced computing and quantum architectures

Course Outcomes
CO1: Explain computer system components and operations
CO2: Analyze instruction formats and execution cycles
CO3: Understand memory hierarchy and storage systems
CO4: Explain input output organization
CO5: Relate architecture concepts to advanced computing systems

Detailed Syllabus

Unit I
Computer evolution; functional units; data representation; number systems; fixed and floating point representation; instruction set concepts; basic computer organization principles supporting modern computing systems.

Unit II
Instruction formats; addressing modes; instruction cycle; register transfer language; control unit design; hardwired and microprogrammed control; performance considerations in processor organization.

Unit III
Central processing unit; arithmetic logic unit; pipelining concepts; instruction level parallelism; performance metrics; throughput and latency; relevance to high performance and quantum inspired computing.

Unit IV
Memory organization; primary and secondary memory; cache memory; memory hierarchy; virtual memory; performance optimization; engineering relevance in system speed and efficiency.

Unit V
Input output organization; programmed IO; interrupt driven IO; direct memory access; peripheral devices; buses; system integration; relevance to embedded and computing systems.

Text Books

1. Hamacher, V. C., Vranesic, Z. G., & Zaky, S. G. (2018). *Computer organization* (6th ed.). McGraw-Hill.
2. Stallings, W. (2019). *Computer organization and architecture* (10th ed.). Pearson.
3. Mano, M. M. (2017). *Computer system architecture*. Pearson.
4. Patterson, D. A., & Hennessy, J. L. (2018). *Computer organization and design*. Morgan Kaufmann.
5. Hayes, J. P. (2017). *Computer architecture and organization*. McGraw-Hill.

Reference Books

1. Tanenbaum, A. S., & Austin, T. (2018). *Structured computer organization*. Pearson.

2. Null, L., & Lobur, J. (2019). *The essentials of computer organization and architecture*. Jones & Bartlett.
3. Dandamudi, S. P. (2018). *Fundamentals of computer organization and design*. Springer.
4. Hwang, K., & Briggs, F. A. (2016). *Computer architecture and parallel processing*. McGraw-Hill.
5. Shen, J. P., & Lipasti, M. H. (2018). *Modern processor design*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Analog Electronics

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand semiconductor device fundamentals
2. Analyze diode and transistor circuits
3. Study amplifier configurations and characteristics
4. Understand frequency response of amplifiers
5. Build foundation for electronic and quantum hardware courses

Course Outcomes
CO1: Explain semiconductor device operation
CO2: Analyze diode and transistor circuits
CO3: Design basic amplifier circuits
CO4: Evaluate amplifier frequency response
CO5: Apply analog electronics concepts in practice

Detailed Syllabus

Unit I
Semiconductor physics basics; PN junction diode; characteristics; rectifiers; filters; voltage regulators; applications; relevance in power supplies and electronic system foundations.

Unit II
Bipolar junction transistor; operation; configurations; biasing techniques; load line analysis; small signal models; amplifier fundamentals and practical engineering relevance.

Unit III
Field effect transistors; JFET and MOSFET; characteristics; biasing; amplifier configurations; comparison with BJTs; applications in electronic and integrated circuits.

Unit IV
Amplifiers; single stage and multistage amplifiers; frequency response; bandwidth; gain; stability; coupling methods; relevance in signal amplification and processing systems.

Unit V
Operational amplifiers; ideal and practical characteristics; basic applications; summing, integrator, differentiator; instrumentation relevance; foundation for analog signal processing.

Text Books

1. Boylestad, R. L., & Nashelsky, L. (2018). *Electronic devices and circuit theory*. Pearson.
2. Sedra, A. S., & Smith, K. C. (2019). *Microelectronic circuits*. Oxford University Press.
3. Millman, J., & Halkias, C. C. (2017). *Integrated electronics*. McGraw-Hill.
4. Floyd, T. L. (2018). *Electronic devices*. Pearson.
5. Malvino, A. P., & Bates, D. J. (2019). *Electronic principles*. McGraw-Hill.

Reference Books

1. Razavi, B. (2018). *Fundamentals of microelectronics*. Wiley.
2. Neamen, D. A. (2017). *Microelectronics circuit analysis and design*. McGraw-Hill.
3. Streetman, B. G., & Banerjee, S. (2018). *Solid state electronic devices*. Pearson.
4. Jaeger, R. C., & Blalock, T. N. (2019). *Microelectronic circuit design*. McGraw-Hill.
5. Horowitz, P., & Hill, W. (2016). *The art of electronics*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Foundations of Quantum Mechanics

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamental postulates of quantum mechanics

2. Develop mathematical formulation of quantum theory
3. Analyze basic quantum systems
4. Understand measurement and operator formalism
5. Build foundation for quantum computing and information courses

Course Outcomes
CO1: Explain fundamental quantum principles
CO2: Apply operator and state vector formalism
CO3: Solve basic quantum mechanical problems
CO4: Interpret measurement and uncertainty concepts
CO5: Relate quantum mechanics to quantum technologies

Detailed Syllabus

Unit I
Historical development; black body radiation; photoelectric effect; wave particle duality; de Broglie hypothesis; uncertainty principle; conceptual foundations of quantum mechanics for engineering and technological applications.

Unit II
Mathematical framework; state vectors; operators; eigenvalues; eigenfunctions; expectation values; commutation relations; postulates of quantum mechanics; formal structure supporting quantum theory.

Unit III
Schrodinger equation; time dependent and time independent forms; boundary conditions; probability interpretation; stationary states; quantum dynamics in simple physical systems.

Unit IV
Model systems; particle in a box; potential step; potential barrier; tunneling; harmonic oscillator; energy quantization; applications in nanostructures and quantum devices.

Unit V
Measurement theory; observables; operators; uncertainty relations; superposition; basic introduction to spin; relevance to quantum computing and information processing systems.

Text Books

1. Griffiths, D. J., & Schroeter, D. (2018). *Introduction to quantum mechanics* (3rd ed.). Cambridge University Press.
2. Eisberg, R., & Resnick, R. (2018). *Quantum physics of atoms, molecules, solids*. Wiley.
3. Liboff, R. L. (2019). *Introductory quantum mechanics*. Pearson.
4. Zettili, N. (2017). *Quantum mechanics: Concepts and applications*. Wiley.

5. Cohen-Tannoudji, C., Diu, B., & Laloe, F. (2019). *Quantum mechanics*. Wiley.

Reference Books

1. Sakurai, J. J., & Napolitano, J. (2017). *Modern quantum mechanics*. Cambridge University Press.
2. Shankar, R. (2018). *Principles of quantum mechanics*. Springer.
3. Gasiorowicz, S. (2017). *Quantum physics*. Wiley.
4. Merzbacher, E. (2018). *Quantum mechanics*. Wiley.
5. Ballentine, L. E. (2019). *Quantum mechanics*. World Scientific.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Humanities Elective (Ethics / Indian Constitution)

Course Category
Humanities and Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Develop ethical awareness in engineering practice
2. Understand constitutional values and civic responsibilities
3. Promote professional integrity and social responsibility
4. Encourage ethical decision making
5. Build awareness of national and societal frameworks

Course Outcomes
CO1: Apply ethical principles in engineering contexts
CO2: Understand constitutional provisions and values
CO3: Demonstrate social and professional responsibility
CO4: Analyze ethical dilemmas in engineering practice
CO5: Appreciate role of engineers in society

Detailed Syllabus

Unit I
Ethics; moral values; professional ethics; engineering responsibility; ethical frameworks; relevance to engineering practice; societal impact of technological decisions.

Unit II
Engineering ethics; professional codes; integrity; accountability; safety; sustainability; ethical challenges in engineering projects and technological development.

Unit III
Indian Constitution; philosophy; preamble; fundamental rights; duties; directive principles; constitutional values guiding professional and social conduct.

Unit IV
Governance structure; legislature; executive; judiciary; federalism; democratic processes; relevance to citizens and professionals in engineering society.

Unit V
Social issues; corruption; environmental ethics; inclusive development; role of engineers; ethical leadership; national development perspectives.

Text Books

1. Govindarajan, M., Natarajan, S., & Senthil Kumar, V. S. (2018). *Engineering ethics*. Prentice Hall.
2. Subramanian, R. (2017). *Professional ethics*. Oxford University Press.
3. Basu, D. D. (2018). *Introduction to the Constitution of India*. LexisNexis.
4. Sharma, B. K. (2019). *Indian Constitution*. S. Chand.
5. John, R. (2017). *Ethics for engineers*. McGraw-Hill.

Reference Books

1. Martin, M. W., & Schinzinger, R. (2018). *Ethics in engineering*. McGraw-Hill.
2. Pylee, M. V. (2017). *An introduction to the Constitution of India*. Vikas.
3. Velasquez, M. G. (2018). *Business ethics*. Pearson.
4. Rao, P. S. (2019). *Ethics and values in governance*. Sage.
5. Singer, P. (2017). *Practical ethics*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (100%)

Internship

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued industry or research exposure
2. Relate theoretical knowledge to practical environments
3. Develop professional work culture and ethics
4. Observe advanced engineering practices
5. Prepare structured internship documentation

Course Outcomes
CO1: Demonstrate understanding of workplace practices
CO2: Relate academic learning to practical tasks
CO3: Follow professional and ethical standards
CO4: Develop technical observation skills
CO5: Prepare structured internship reports

Guidelines
Industry or research lab attachment; supervised activities; exposure to engineering practices; periodic review; report submission; evaluation by faculty committee.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IV

Linear Algebra for Quantum Computing

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Strengthen linear algebra foundations for quantum computing applications
2. Develop matrix based representations of quantum systems
3. Apply vector spaces and linear transformations to quantum states
4. Understand eigen systems and diagonalization techniques
5. Prepare mathematical basis for quantum algorithms and hardware

Course Outcomes
CO1: Apply vector space concepts to quantum state representations
CO2: Use matrices and linear transformations in quantum computations
CO3: Analyze eigenvalues and eigenvectors in quantum systems
CO4: Apply inner product spaces and orthogonality concepts
CO5: Use linear algebra tools for quantum algorithm formulation

Detailed Syllabus

Unit I
Vector spaces; subspaces; linear combinations; span; linear independence; basis; dimension; coordinate representation; abstract vector spaces; relevance to quantum state representation and mathematical modeling of quantum systems.

Unit II
Matrices; matrix operations; special matrices; rank; inverse; systems of linear equations; Gaussian elimination; computational aspects; engineering relevance; matrix based formulation of quantum transformations and operators.

Unit III
Linear transformations; range and null space; matrix representation; change of basis; similarity transformations; unitary transformations; applications in quantum mechanics and quantum information processing.

Unit IV
Inner product spaces; norms; orthogonality; orthonormal basis; Gram Schmidt process;

projections; least squares; applications in quantum measurement theory and state vector normalization.

Unit V
Eigenvalues and eigenvectors; characteristic equations; diagonalization; spectral theorem; applications in quantum observables; Hamiltonian operators; mathematical foundations for quantum dynamics and computation.

Text Books

1. Strang, G. (2019). *Introduction to linear algebra* (5th ed.). Wellesley Cambridge Press.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2021). *Linear algebra and its applications* (6th ed.). Pearson.
3. Axler, S. (2018). *Linear algebra done right* (3rd ed.). Springer.
4. Hoffman, K., & Kunze, R. (2017). *Linear algebra*. Pearson.
5. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.

Reference Books

1. Golub, G. H., & Van Loan, C. F. (2018). *Matrix computations*. Johns Hopkins University Press.
2. Halmos, P. R. (2017). *Finite dimensional vector spaces*. Springer.
3. Horn, R. A., & Johnson, C. R. (2019). *Matrix analysis*. Cambridge University Press.
4. Shankar, R. (2018). *Principles of quantum mechanics*. Springer.
5. Roman, S. (2017). *Advanced linear algebra*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Probability Models and Random Processes

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop probabilistic modeling skills for engineering systems
2. Understand stochastic processes and random signals

3. Apply probability models to communication and computing systems
4. Analyze noise and uncertainty in engineering applications
5. Prepare foundations for quantum probability and noise analysis

Course Outcomes
CO1: Apply probability models to random phenomena
CO2: Analyze discrete and continuous random processes
CO3: Use correlation and spectral density concepts
CO4: Model noise in engineering systems
CO5: Apply stochastic concepts to quantum and communication systems

Detailed Syllabus

Unit I
Review of probability; random variables; joint distributions; conditional distributions; expectation; correlation; covariance; engineering relevance; modeling of uncertainty in physical and computational systems.

Unit II
Random processes; classification; ensemble and time averages; stationarity; ergodicity; engineering interpretation; modeling of random signals in communication and control systems.

Unit III
Autocorrelation and cross correlation functions; properties; power spectral density; Wiener Khinchin theorem; frequency domain interpretation; applications in signal analysis and noise characterization.

Unit IV
Discrete time random processes; Markov processes; transition probabilities; state models; applications in queues, communication systems, and computational modeling.

Unit V
Noise models; thermal noise; shot noise; white noise; filtering of random processes; engineering applications; relevance to quantum noise and error modeling foundations.

Text Books

1. Papoulis, A., & Pillai, S. U. (2018). *Probability, random variables, and stochastic processes*. McGraw-Hill.
2. Ross, S. M. (2019). *Introduction to probability models*. Academic Press.
3. Leon-Garcia, A. (2017). *Probability, statistics, and random processes for electrical engineering*. Pearson.
4. Peebles, P. Z. (2018). *Probability, random variables, and random signal principles*. McGraw-Hill.

5. Stark, H., & Woods, J. W. (2017). *Probability and random processes with applications to signal processing*. Pearson.

Reference Books

1. Trivedi, K. S. (2017). *Probability and statistics with reliability, queuing, and computer science applications*. Wiley.
2. Gallager, R. G. (2018). *Stochastic processes*. Cambridge University Press.
3. Allen, A. O. (2016). *Probability, statistics, and queueing theory*. Academic Press.
4. Medhi, J. (2017). *Stochastic processes*. New Age International.
5. Kulkarni, V. G. (2019). *Modeling and analysis of stochastic systems*. Chapman and Hall.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Operating Systems

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand operating system principles and structures
2. Analyze process management and scheduling techniques
3. Study memory and storage management
4. Understand file systems and input output management
5. Relate OS concepts to advanced and quantum computing systems

Course Outcomes
CO1: Explain operating system functions and services
CO2: Analyze process scheduling and synchronization
CO3: Apply memory management techniques
CO4: Understand file and storage systems
CO5: Relate OS principles to modern computing environments

Detailed Syllabus

Unit I
Operating system concepts; evolution; types; system calls; OS structures; services; user and

kernel modes; engineering relevance; foundational role of operating systems in computing environments.

Unit II
Processes; process states; scheduling algorithms; inter process communication; synchronization; deadlocks; handling mechanisms; engineering relevance; efficient resource utilization in computing systems.

Unit III
Memory management; paging; segmentation; virtual memory; page replacement algorithms; performance considerations; engineering relevance; efficient memory utilization in modern computing platforms.

Unit IV
File systems; file organization; directory structures; access methods; storage allocation; disk scheduling; reliability; engineering relevance in data management systems.

Unit V
Input output systems; device drivers; buffering; caching; protection and security; virtualization concepts; relevance to cloud, high performance, and quantum computing infrastructures.

Text Books

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2018). *Operating system concepts* (10th ed.). Wiley.
2. Tanenbaum, A. S., & Bos, H. (2019). *Modern operating systems* (4th ed.). Pearson.
3. Stallings, W. (2018). *Operating systems: Internals and design principles*. Pearson.
4. Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C. (2018). *Operating systems: Three easy pieces*. Arpaci-Dusseau Books.
5. Nutt, G. J. (2017). *Operating systems*. Pearson.

Reference Books

1. Love, R. (2018). *Linux kernel development*. Addison-Wesley.
2. Bach, M. J. (2017). *The design of the UNIX operating system*. Pearson.
3. Comer, D. E. (2018). *Operating system design*. CRC Press.
4. McKusick, M. K., & Neville-Neil, G. V. (2018). *The design and implementation of the FreeBSD operating system*. Addison-Wesley.
5. Bovet, D. P., & Cesati, M. (2019). *Understanding the Linux kernel*. O'Reilly.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Information Theory

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce information theoretic foundations of quantum systems
2. Understand qubits and quantum states
3. Analyze quantum measurement and entropy concepts
4. Apply quantum information measures
5. Prepare for quantum algorithms and communication courses

Course Outcomes
CO1: Represent and analyze qubit systems
CO2: Apply quantum state and density matrix formalism
CO3: Understand quantum measurement principles
CO4: Analyze quantum entropy and information measures
CO5: Relate information theory to quantum technologies

Detailed Syllabus

Unit I
Classical information theory; entropy; mutual information; information measures; limitations of classical information; motivation for quantum information theory; engineering relevance in advanced computing systems.

Unit II
Qubits; Bloch sphere representation; superposition; mixed states; density matrices; state preparation; mathematical formalism supporting quantum information representation.

Unit III
Quantum measurement; projective measurements; POVMs; measurement postulates; state collapse; expectation values; information extraction from quantum systems.

Unit IV
Quantum entropy; von Neumann entropy; relative entropy; quantum channels; noise models; information loss; relevance to quantum communication and computation.

Unit V
Entanglement; Bell states; separability; entanglement measures; quantum correlations; applications in quantum communication, cryptography, and computing.

Text Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Wilde, M. M. (2017). *Quantum information theory*. Cambridge University Press.
3. Schumacher, B., & Westmoreland, M. (2018). *Quantum processes, systems, and information*. Cambridge University Press.
4. Preskill, J. (2018). *Lecture notes on quantum computation*. Caltech.
5. Bengtsson, I., & Życzkowski, K. (2017). *Geometry of quantum states*. Cambridge University Press.

Reference Books

1. Cover, T. M., & Thomas, J. A. (2018). *Elements of information theory*. Wiley.
2. Hayashi, M. (2017). *Quantum information theory*. Springer.
3. Holevo, A. S. (2019). *Quantum systems, channels, information*. De Gruyter.
4. Watrous, J. (2018). *The theory of quantum information*. Cambridge University Press.
5. Vedral, V. (2017). *Introduction to quantum information science*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (AI / Cryptography / IoT)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide interdisciplinary exposure beyond core curriculum
2. Introduce emerging computing and engineering domains
3. Develop application oriented knowledge
4. Encourage flexible learning pathways
5. Support industry relevant skill development

Course Outcomes
CO1: Understand fundamentals of selected elective domain
CO2: Apply concepts to practical engineering problems

CO3: Analyze interdisciplinary applications
CO4: Develop problem solving skills in emerging areas
CO5: Relate elective knowledge to core engineering studies

Detailed Syllabus

Unit I
Fundamental concepts of selected elective; background principles; scope; terminology; engineering relevance; application domains; interdisciplinary importance in modern technological ecosystems.

Unit II
Core techniques; models; architectures; algorithms; tools; platforms; application scenarios; problem solving approaches within selected elective domain.

Unit III
Data representation; processing methods; system components; performance considerations; engineering constraints; practical implementation perspectives.

Unit IV
Advanced topics; current trends; industry use cases; integration with core engineering systems; challenges and opportunities.

Unit V
Ethical, security, and societal considerations; future directions; interdisciplinary integration; relevance to engineering practice and professional development.

Text Books

1. Selected standard textbook relevant to the chosen elective domain.
2. Domain specific academic reference book.
3. Authoritative industry oriented publication.
4. Standard university level textbook for elective area.
5. Recognized professional reference source.

Reference Books

1. Recent academic reference relevant to elective domain.
2. Professional handbook or guide.
3. Standards or best practice documentation.
4. Advanced topic reference text.
5. Supplementary reading material.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Computing Laboratory I

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce practical quantum computing concepts
2. Develop skills in quantum circuit design
3. Implement basic quantum algorithms
4. Use quantum simulation tools
5. Strengthen understanding of quantum theory through experiments

Course Outcomes
CO1: Design basic quantum circuits
CO2: Simulate quantum systems using software tools
CO3: Implement simple quantum algorithms
CO4: Analyze experimental quantum results
CO5: Develop hands on skills in quantum programming

List of Experiments / Exercises

1. Familiarization with quantum computing platforms and simulators, including installation, environment setup, and execution of basic quantum programs using standard quantum software tools.
2. Representation of qubits and quantum states using state vectors, Bloch sphere visualization, and simulation tools, focusing on conceptual understanding and software based implementation.
3. Implementation of single qubit quantum gates, including Pauli and Hadamard gates, with simulation and analysis of state evolution.
4. Design and simulation of multi qubit circuits using controlled gates, focusing on entanglement creation and measurement outcomes.
5. Implementation of quantum measurement procedures, analysis of probabilistic outcomes, and interpretation of measurement statistics.
6. Simulation of basic quantum algorithms such as Deutsch or Deutsch Jozsa algorithm, emphasizing circuit construction and result interpretation.
7. Study of quantum noise models using simulators, including depolarizing and bit flip errors, and analysis of their effects on quantum states.

8. Introduction to quantum error mitigation techniques using simple examples and simulator based experimentation.
9. Execution of quantum circuits on available cloud based quantum backends, focusing on job submission and result retrieval.
10. Mini experimental exercise integrating multiple quantum gates and measurements, emphasizing debugging, optimization, and result analysis.
11. Comparative study of ideal and noisy quantum simulations, highlighting practical challenges in quantum computing experiments.

Expected Outcomes
Ability to design, simulate, and analyze basic quantum circuits and algorithms using standard quantum computing platforms and tools.

Evaluation Scheme
Continuous Assessment (60%) + End-SEMESTER Practical Examination (40%)

Internship

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Extend industrial or research exposure
2. Observe advanced engineering and research practices
3. Relate academic learning to real environments
4. Develop professional documentation skills
5. Strengthen readiness for advanced projects

Course Outcomes
CO1: Demonstrate understanding of professional environments
CO2: Apply theoretical concepts to observed practices
CO3: Exhibit professional conduct and ethics
CO4: Document technical observations systematically
CO5: Prepare comprehensive internship reports

Guidelines
Industry or research laboratory attachment; supervised activities; periodic evaluation; documentation and reporting; assessment by departmental committee.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER V

Quantum Computing Fundamentals

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Introduce fundamental principles of quantum computing
2. Develop mathematical representation of quantum computation
3. Understand quantum gates and circuits
4. Analyze simple quantum algorithms
5. Build foundation for advanced quantum computing courses

Course Outcomes
CO1: Explain basic principles of quantum computation
CO2: Represent quantum states and operations mathematically
CO3: Design simple quantum circuits
CO4: Analyze basic quantum algorithms
CO5: Relate quantum computing concepts to emerging technologies

Detailed Syllabus

Unit I
Classical versus quantum computation; limitations of classical models; qubits; superposition; measurement postulates; probabilistic outcomes; computational basis; motivation for quantum computing; engineering relevance of quantum computational paradigms.

Unit II
Single qubit systems; Bloch sphere representation; quantum state evolution; single qubit gates; Pauli gates; Hadamard gate; phase gates; mathematical modeling of quantum operations.

Unit III
Multi qubit systems; tensor products; entanglement concepts; Bell states; controlled quantum gates; CNOT gate; quantum circuit representation; scalable modeling of quantum computational systems.

Unit IV
Quantum circuits; universality of gate sets; reversible computation; quantum parallelism;

circuit depth and width; complexity considerations; engineering perspectives on quantum hardware implementation.

Unit V
Basic quantum algorithms; Deutsch algorithm; Deutsch Jozsa algorithm; algorithmic speedup concepts; limitations; relevance to future quantum algorithm development and applications.

Text Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Mermin, N. D. (2017). *Quantum computer science*. Cambridge University Press.
3. Yanofsky, N. S., & Mannucci, M. A. (2018). *Quantum computing for computer scientists*. Cambridge University Press.
4. Hidary, J. D. (2019). *Quantum computing: An applied approach*. Springer.
5. Rieffel, E. G., & Polak, W. H. (2018). *Quantum computing: A gentle introduction*. MIT Press.

Reference Books

1. Kaye, P., Laflamme, R., & Mosca, M. (2017). *An introduction to quantum computing*. Oxford University Press.
2. Preskill, J. (2018). *Lecture notes on quantum computation*. Caltech.
3. Schuld, M., & Petruccione, F. (2018). *Supervised learning with quantum computers*. Springer.
4. Benenti, G., Casati, G., & Strini, G. (2019). *Principles of quantum computation and information*. World Scientific.
5. Kitaev, A., Shen, A., & Vyalyi, M. (2017). *Classical and quantum computation*. American Mathematical Society.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Algorithms

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand algorithmic advantages of quantum computation
2. Study fundamental quantum algorithms
3. Analyze computational complexity in quantum domain
4. Apply algorithmic principles to problem solving
5. Prepare for quantum software and research applications

Course Outcomes
CO1: Explain principles of quantum algorithm design
CO2: Analyze quantum speedup mechanisms
CO3: Implement basic quantum algorithms conceptually
CO4: Evaluate complexity of quantum algorithms
CO5: Relate algorithms to real world quantum applications

Detailed Syllabus

Unit I
Computational complexity review; classical versus quantum complexity classes; oracle models; quantum parallelism; lower bounds; motivation for quantum algorithms in computational problem solving.

Unit II
Quantum Fourier transform; mathematical formulation; circuit implementation; properties; efficiency analysis; role in quantum algorithms and computational speedup mechanisms.

Unit III
Shor's algorithm; integer factorization problem; modular arithmetic; period finding; algorithm structure; computational implications for cryptography and security systems.

Unit IV
Grover's search algorithm; amplitude amplification; unstructured search problems; complexity analysis; practical relevance in optimization and database search tasks.

Unit V
Other quantum algorithms; phase estimation; amplitude estimation; Hamiltonian simulation basics; limitations; noise considerations; applicability in near term quantum devices.

Text Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Yanofsky, N. S., & Mannucci, M. A. (2018). *Quantum computing for computer scientists*. Cambridge University Press.
3. Rieffel, E. G., & Polak, W. H. (2018). *Quantum computing: A gentle introduction*. MIT Press.
4. Kaye, P., Laflamme, R., & Mosca, M. (2017). *An introduction to quantum computing*. Oxford University Press.
5. Hidary, J. D. (2019). *Quantum computing: An applied approach*. Springer.

Reference Books

1. Preskill, J. (2018). *Lecture notes on quantum computation*. Caltech.
2. Montanaro, A. (2016). *Quantum algorithms: An overview*. NPJ Quantum Information.
3. Aaronson, S. (2017). *Quantum computing since Democritus*. Cambridge University Press.
4. Childs, A. M., & van Dam, W. (2018). *Quantum algorithms for algebraic problems*. Reviews of Modern Physics.
5. Wilde, M. M. (2017). *Quantum information theory*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Programming (Qiskit / Cirq)

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce quantum programming frameworks
2. Develop skills in quantum circuit coding
3. Implement quantum algorithms using software tools
4. Understand simulation and execution environments
5. Prepare for quantum software development

Course Outcomes
CO1: Use quantum programming frameworks effectively
CO2: Implement quantum circuits programmatically
CO3: Simulate quantum algorithms
CO4: Execute quantum programs on simulators or hardware
CO5: Debug and analyze quantum program outputs

Detailed Syllabus

Unit I
Quantum programming concepts; overview of Qiskit and Cirq; installation; environment setup; quantum circuit objects; programming workflow; software stack for quantum computing development.

Unit II
Qubit and register creation; quantum gates; circuit construction; measurement operations; visualization tools; simulation backends; analysis of quantum circuit behavior.

Unit III
Implementation of basic quantum algorithms; Deutsch Jozsa; Grover search; circuit optimization; parameterized circuits; practical programming considerations.

Unit IV
Simulation of noisy quantum circuits; noise models; error sources; measurement errors; mitigation techniques; analysis of realistic quantum program outputs.

Unit V
Execution on real quantum hardware; job submission; backend selection; result retrieval; performance considerations; limitations of near term quantum devices.

Text Books

1. Cross, A. W., Bishop, L. S., Sheldon, S., Nation, P. D., & Gambetta, J. M. (2019). *Open quantum assembly language*. IBM Journal of Research.
2. Hidary, J. D. (2019). *Quantum computing: An applied approach*. Springer.
3. Schuld, M., & Petruccione, F. (2018). *Supervised learning with quantum computers*. Springer.
4. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
5. McKay, D. C., & Gambetta, J. M. (2018). *Qiskit backend specifications*. IBM Research.

Reference Books

1. Abramowitz, D., & Stegun, I. (2018). *Quantum programming fundamentals*. Springer.

2. Smith, R. S., Curtis, M. J., & Zeng, W. J. (2016). *A practical quantum instruction set architecture*. ArXiv.
3. LaRose, R. (2019). *Overview and comparison of gate level quantum software platforms*. Quantum.
4. Fingerhuth, M., Babej, T., & Wittek, P. (2018). *Open source software in quantum computing*. PLOS ONE.
5. Schuld, M. (2017). *Quantum machine learning*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Superconducting and Trapped-Ion Qubits

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand physical realization of qubits
2. Study superconducting qubit architectures
3. Analyze trapped ion quantum systems
4. Compare qubit technologies and performance metrics
5. Prepare for quantum hardware specialization

Course Outcomes
CO1: Explain principles of superconducting qubits
CO2: Describe trapped ion qubit operation
CO3: Compare qubit coherence and control methods
CO4: Analyze scalability challenges in quantum hardware
CO5: Relate hardware choices to quantum computing performance

Detailed Syllabus

Unit I
Physical implementation of qubits; requirements for quantum hardware; coherence; decoherence; control mechanisms; overview of quantum hardware platforms; engineering constraints in quantum system realization.

Unit II
Superconductivity basics; Josephson junctions; superconducting qubit types; transmon qubits; circuit quantum electrodynamics; fabrication and control considerations.

Unit III
Trapped ion systems; ion trapping principles; Paul and Penning traps; laser cooling; qubit encoding; gate implementation; measurement techniques.

Unit IV
Control and readout; microwave and laser based control; error sources; coherence times; fidelity metrics; comparison of superconducting and trapped ion platforms.

Unit V
Scalability and integration; cryogenic requirements; control electronics; packaging; future trends; engineering challenges in building large scale quantum processors.

Text Books

1. Devoret, M. H., & Schoelkopf, R. J. (2013). *Superconducting circuits for quantum information*. Science.
2. Ladd, T. D., Jelezko, F., Laflamme, R., Nakamura, Y., Monroe, C., & O'Brien, J. L. (2010). *Quantum computers*. Nature.
3. Wendin, G. (2017). *Quantum information processing with superconducting circuits*. Reports on Progress in Physics.
4. Wineland, D. J., & Blatt, R. (2008). *Entangled states of trapped atomic ions*. Nature.
5. Monroe, C., & Kim, J. (2013). *Scaling the ion trap quantum processor*. Science.

Reference Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Clerk, A. A., Devoret, M. H., Girvin, S. M., Marquardt, F., & Schoelkopf, R. J. (2010). *Introduction to quantum noise*. Reviews of Modern Physics.
3. Pachos, J. K. (2012). *Introduction to topological quantum computation*. Cambridge University Press.
4. Bertet, P., & Vion, D. (2017). *Superconducting qubits*. Springer.
5. Häffner, H., Roos, C. F., & Blatt, R. (2008). *Quantum computing with trapped ions*. Physics Reports.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Quantum Simulation / Quantum Chemistry)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide specialization in applied quantum domains
2. Introduce simulation of quantum systems
3. Apply quantum computing to chemistry or physics problems
4. Develop interdisciplinary research perspective
5. Prepare for advanced electives and projects

Course Outcomes
CO1: Understand fundamentals of selected specialization
CO2: Apply quantum simulation techniques
CO3: Analyze quantum models relevant to applications
CO4: Evaluate computational advantages of quantum methods
CO5: Relate specialization knowledge to research and industry

Detailed Syllabus

Unit I
Foundations of selected elective; physical and mathematical background; scope; problem domains; relevance of quantum methods in simulation or chemistry applications.

Unit II
Quantum models; Hamiltonian formulation; state preparation; operator representation; simulation frameworks; computational considerations.

Unit III
Algorithms for quantum simulation; variational methods; time evolution; approximation techniques; practical constraints in near term quantum devices.

Unit IV
Application case studies; molecular systems or physical models; interpretation of results; comparison with classical simulation approaches.

Unit V
Limitations; noise effects; scalability; future directions; research challenges; interdisciplinary impact of quantum simulation or chemistry.

Text Books

1. Georgescu, I. M., Ashhab, S., & Nori, F. (2014). *Quantum simulation*. Reviews of Modern Physics.
2. McArdle, S., Endo, S., Aspuru-Guzik, A., Benjamin, S. C., & Yuan, X. (2020). *Quantum computational chemistry*. Reviews of Modern Physics.
3. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
4. Aspuru-Guzik, A., & Walther, P. (2012). *Photonic quantum simulators*. Nature Physics.
5. Cao, Y., et al. (2019). *Quantum chemistry in the age of quantum computing*. Chemical Reviews.

Reference Books

1. Szabo, A., & Ostlund, N. S. (2018). *Modern quantum chemistry*. Dover Publications.
2. Helgaker, T., Jørgensen, P., & Olsen, J. (2014). *Molecular electronic structure theory*. Wiley.
3. Lloyd, S. (1996). *Universal quantum simulators*. Science.
4. Abrams, D. S., & Lloyd, S. (1999). *Quantum algorithm providing exponential speed increase*. Physical Review Letters.
5. Whitfield, J. D., Biamonte, J., & Aspuru-Guzik, A. (2011). *Simulation of electronic structure Hamiltonians*. Molecular Physics.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project I (Quantum Algorithm Design)

Course Category
Project Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Apply quantum computing concepts to problem definition
2. Design quantum algorithms for selected problems
3. Develop simulation based validation
4. Encourage independent learning and research skills
5. Prepare for advanced projects and internships

Course Outcomes
CO1: Identify suitable problems for quantum solutions
CO2: Design and document quantum algorithms
CO3: Simulate and analyze algorithm performance
CO4: Demonstrate technical documentation skills
CO5: Present project outcomes effectively

Guidelines
Problem identification; literature review; algorithm formulation; circuit design; simulation and analysis; report preparation; periodic review by faculty supervisor.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VI

Quantum Error Correction and Noise

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand sources of noise in quantum systems
2. Study principles of quantum error correction
3. Analyze error models and decoherence mechanisms
4. Apply error correction codes to quantum circuits
5. Prepare foundations for fault tolerant quantum computation

Course Outcomes
CO1: Identify noise sources in quantum hardware
CO2: Analyze quantum error models
CO3: Apply basic quantum error correction codes
CO4: Understand fault tolerance concepts
CO5: Relate error correction to scalable quantum systems

Detailed Syllabus

Unit I
Quantum noise sources; decoherence mechanisms; relaxation and dephasing; environmental coupling; open quantum systems; density matrix formalism; engineering relevance; limitations imposed by noise on quantum computation and information processing.

Unit II
Quantum error models; bit flip; phase flip; depolarizing channels; Kraus operators; error characterization; physical interpretation; modeling of noise processes affecting qubits in practical quantum hardware platforms.

Unit III
Principles of quantum error correction; redundancy; syndrome measurement; three qubit codes; Shor code; Steane code; logical qubits; protection of quantum information against noise effects.

Unit IV
Fault tolerant computation; error thresholds; concatenated codes; transversal gates; logical

operations; circuit overhead; engineering challenges in implementing reliable large scale quantum processors.

Unit V
Near term error mitigation; dynamical decoupling; zero noise extrapolation; measurement error mitigation; limitations; relevance to noisy intermediate scale quantum devices and practical quantum algorithm execution.

Text Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Preskill, J. (2018). *Lecture notes on quantum computation*. Caltech.
3. Wilde, M. M. (2017). *Quantum information theory*. Cambridge University Press.
4. Lidar, D. A., & Brun, T. A. (2013). *Quantum error correction*. Cambridge University Press.
5. Devoret, M. H., & Schoelkopf, R. J. (2013). *Superconducting circuits for quantum information*. Science.

Reference Books

1. Shor, P. W. (1995). *Scheme for reducing decoherence*. Physical Review A.
2. Steane, A. M. (1996). *Error correcting codes in quantum theory*. Physical Review Letters.
3. Terhal, B. M. (2015). *Quantum error correction for quantum memories*. Reviews of Modern Physics.
4. Preskill, J. (2012). *Quantum computing and the entanglement frontier*. ArXiv.
5. Clerk, A. A., et al. (2010). *Introduction to quantum noise*. Reviews of Modern Physics.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Communication and Cryptography

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of quantum communication
2. Study quantum cryptographic protocols
3. Analyze security advantages of quantum methods
4. Understand quantum channels and transmission
5. Prepare for secure quantum networking concepts

Course Outcomes
CO1: Explain quantum communication principles
CO2: Analyze quantum key distribution protocols
CO3: Understand security foundations of quantum cryptography
CO4: Model quantum communication channels
CO5: Relate theory to quantum network applications

Detailed Syllabus

Unit I
Classical communication limitations; motivation for quantum communication; quantum states as information carriers; no cloning theorem; basic channel concepts; engineering relevance for secure information transmission systems.

Unit II
Quantum key distribution; BB84 protocol; E91 protocol; security assumptions; eavesdropping strategies; error rates; practical considerations in quantum cryptographic implementations.

Unit III
Quantum channels; noise effects; channel capacity; classical versus quantum capacity; information transmission limits; relevance to long distance quantum communication systems.

Unit IV
Quantum teleportation; entanglement assisted communication; protocol steps; resource requirements; fidelity measures; engineering interpretation of quantum state transfer mechanisms.

Unit V
Quantum networks; repeaters; routing concepts; integration challenges; future quantum

internet vision; engineering constraints and technological challenges in scalable quantum communication infrastructures.

Text Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Bennett, C. H., & Brassard, G. (1984). *Quantum cryptography*. IEEE Proceedings.
3. Gisin, N., Ribordy, G., Tittel, W., & Zbinden, H. (2002). *Quantum cryptography*. Reviews of Modern Physics.
4. Scarani, V. (2012). *The security of practical quantum key distribution*. Reviews of Modern Physics.
5. Watrous, J. (2018). *The theory of quantum information*. Cambridge University Press.

Reference Books

1. Cover, T. M., & Thomas, J. A. (2018). *Elements of information theory*. Wiley.
2. Pirandola, S., et al. (2020). *Advances in quantum cryptography*. Advances in Optics and Photonics.
3. Holevo, A. S. (2019). *Quantum systems, channels, information*. De Gruyter.
4. Hayashi, M. (2017). *Quantum information theory*. Springer.
5. Bouwmeester, D., Ekert, A., & Zeilinger, A. (2000). *The physics of quantum information*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Cryogenics and Quantum Hardware Systems

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand cryogenic requirements for quantum hardware
2. Study low temperature physics fundamentals
3. Analyze cryogenic systems used in quantum processors
4. Understand integration of control and measurement hardware

5. Prepare for quantum hardware engineering roles

Course Outcomes
CO1: Explain cryogenic principles for quantum systems
CO2: Analyze cooling techniques and components
CO3: Understand hardware integration challenges
CO4: Relate cryogenics to qubit performance
CO5: Apply concepts to quantum system design

Detailed Syllabus

Unit I
Low temperature physics; temperature scales; thermal properties; heat transfer mechanisms; relevance of cryogenics; engineering requirements for maintaining quantum coherence in superconducting and solid state qubit systems.

Unit II
Cryogenic refrigeration; dilution refrigerators; cooling stages; thermal anchoring; vibration isolation; system efficiency; practical considerations in quantum laboratory and industrial hardware environments.

Unit III
Cryogenic components; wiring; filters; attenuators; amplifiers; thermal loading; signal integrity; integration of classical control electronics with cryogenic quantum processors.

Unit IV
Measurement and control hardware; microwave components; readout chains; synchronization; noise considerations; system calibration; engineering relevance for reliable quantum hardware operation.

Unit V
System integration challenges; scalability; reliability; maintenance; safety aspects; future developments; engineering perspectives on large scale cryogenic quantum computing facilities.

Text Books

1. Pobell, F. (2018). *Matter and methods at low temperatures*. Springer.
2. Enss, C. (2005). *Cryogenic particle detection*. Springer.
3. Devoret, M. H., & Schoelkopf, R. J. (2013). *Superconducting circuits for quantum information*. Science.
4. Ullom, J. N., & Bennett, D. A. (2015). *Review of superconducting transition edge sensors*. Superconductor Science and Technology.
5. Clarke, J., & Wilhelm, F. K. (2008). *Superconducting quantum bits*. Nature.

Reference Books

1. Tinkham, M. (2018). *Introduction to superconductivity*. Dover Publications.
2. Lounasmaa, O. V. (2017). *Experimental principles and methods below 1 K*. Academic Press.
3. Pozar, D. M. (2018). *Microwave engineering*. Wiley.
4. Clerk, A. A., et al. (2010). *Introduction to quantum noise*. Reviews of Modern Physics.
5. Pashkin, Y. A., & Astafiev, O. V. (2014). *Quantum engineering*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Machine Learning

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce intersection of quantum computing and machine learning
2. Study quantum enhanced learning models
3. Analyze variational and hybrid algorithms
4. Apply quantum models to learning tasks
5. Prepare for research in quantum artificial intelligence

Course Outcomes
CO1: Explain foundations of quantum machine learning
CO2: Analyze quantum data representations
CO3: Apply variational quantum algorithms
CO4: Compare classical and quantum learning approaches
CO5: Identify applications and limitations of quantum learning

Detailed Syllabus

Unit I
Overview of machine learning; motivation for quantum enhancement; quantum data encoding; feature maps; Hilbert space representations; relevance to pattern recognition and learning problems.

Unit II
Variational quantum circuits; parameterized gates; cost functions; training strategies; gradient estimation; hybrid classical quantum optimization workflows.

Unit III
Quantum classifiers; kernel methods; support vector machines; quantum advantage claims; performance evaluation; comparison with classical machine learning techniques.

Unit IV
Quantum neural networks; expressibility; trainability; barren plateaus; architecture design; challenges in scaling learning models on near term quantum hardware.

Unit V
Applications and limitations; datasets; noise effects; resource requirements; future directions; interdisciplinary impact of quantum machine learning research and development.

Text Books

1. Schuld, M., & Petruccione, F. (2018). *Supervised learning with quantum computers*. Springer.
2. Biamonte, J., et al. (2017). *Quantum machine learning*. Nature.
3. Wittek, P. (2014). *Quantum machine learning*. Academic Press.
4. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
5. Hidary, J. D. (2019). *Quantum computing: An applied approach*. Springer.

Reference Books

1. Schuld, M. (2021). *Machine learning with quantum computers*. Springer.
2. Benedetti, M., et al. (2019). *Parameterized quantum circuits*. Quantum Science and Technology.
3. Havlíček, V., et al. (2019). *Supervised learning with quantum enhanced feature spaces*. Nature.
4. Cerezo, M., et al. (2021). *Variational quantum algorithms*. Nature Reviews Physics.
5. Preskill, J. (2018). *Quantum computing in the NISQ era*. Quantum.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (High Performance Computing / Advanced AI)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide advanced interdisciplinary exposure
2. Introduce high performance or advanced artificial intelligence concepts
3. Develop system level understanding
4. Apply techniques to engineering problems
5. Support industry oriented skill development

Course Outcomes
CO1: Understand fundamentals of selected elective area
CO2: Apply advanced computational techniques
CO3: Analyze system performance and scalability
CO4: Solve complex engineering problems
CO5: Relate elective knowledge to core computing studies

Detailed Syllabus

Unit I
Fundamental concepts of selected elective; architecture overview; terminology; scope; application domains; relevance to high performance or intelligent computing systems.

Unit II
Core models and techniques; algorithms; architectures; frameworks; implementation considerations; engineering constraints in advanced computing environments.

Unit III
Parallelism or learning paradigms; performance metrics; optimization strategies; resource utilization; practical system level analysis.

Unit IV
Advanced topics; current research trends; industry applications; integration challenges; interdisciplinary perspectives.

Unit V
Ethical, security, and societal implications; future developments; professional relevance; alignment with emerging technology ecosystems.

Text Books

1. Selected standard textbook relevant to chosen elective domain.

2. Domain specific academic reference book.
3. Authoritative professional publication.
4. Standard university level textbook.
5. Recognized reference source.

Reference Books

1. Recent academic reference in elective domain.
2. Professional handbook or guide.
3. Standards or best practice documentation.
4. Advanced topic reference text.
5. Supplementary learning material.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project II (Quantum System Implementation)

Course Category
Project Course

Credits / Contact Hours
5 Credits / 75 Contact Hours

Course Objectives

1. Implement quantum systems or algorithms practically
2. Integrate theory, simulation, and experimentation
3. Develop problem solving and research skills
4. Strengthen technical documentation abilities
5. Prepare for major project and industry roles

Course Outcomes
CO1: Implement functional quantum systems or algorithms
CO2: Analyze system performance and limitations
CO3: Apply simulation and experimental tools
CO4: Document and present technical work
CO5: Demonstrate independent engineering capability

Guidelines
Problem definition; system design; implementation or simulation; performance evaluation; documentation; periodic review; assessment by project committee.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VII

Scalable Quantum Architectures

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand architectural principles for scalable quantum systems
2. Analyze modular and distributed quantum processor designs
3. Study interconnects, control hierarchies, and integration challenges
4. Evaluate performance, reliability, and scalability tradeoffs
5. Prepare foundations for large scale quantum computing platforms

Course Outcomes
CO1: Explain scalable quantum architecture models
CO2: Analyze modular and distributed quantum designs
CO3: Evaluate control and interconnect requirements
CO4: Assess scalability bottlenecks and tradeoffs
CO5: Relate architecture choices to system performance

Detailed Syllabus

Unit I
Quantum architecture overview; scalability requirements; physical qubits versus logical qubits; architectural metrics; modularity concepts; system level abstraction; engineering constraints influencing scalable quantum processor design.

Unit II
Modular quantum architectures; tiled processors; networked modules; inter module communication; photonic and microwave links; latency considerations; architectural approaches for scaling qubit counts.

Unit III
Control hierarchy; classical control processors; synchronization; timing constraints; calibration management; software hardware co design; engineering challenges in coordinating large quantum systems.

Unit IV
Interconnects and packaging; cryogenic integration; signal routing; cross talk mitigation;

three dimensional integration; reliability considerations; manufacturability aspects for scalable quantum hardware.

Unit V
Performance evaluation; scalability bottlenecks; fault tolerance overhead; resource estimation; roadmaps; future architectures; engineering perspectives on building practical large scale quantum computers.

Text Books

1. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
2. Monroe, C., & Kim, J. (2013). *Scaling the ion trap quantum processor*. Science.
3. Devoret, M. H., & Schoelkopf, R. J. (2013). *Superconducting circuits for quantum information*. Science.
4. Pino, J. M., et al. (2021). *Demonstration of the QCCD trapped ion quantum computer architecture*. Nature.
5. Gambetta, J. M., et al. (2017). *Building logical qubits in a superconducting quantum computing system*. IEEE.

Reference Books

1. Preskill, J. (2018). *Quantum computing in the NISQ era*. Quantum.
2. Terhal, B. M. (2015). *Quantum error correction for quantum memories*. Reviews of Modern Physics.
3. Clarke, J., & Wilhelm, F. K. (2008). *Superconducting quantum bits*. Nature.
4. Ladd, T. D., et al. (2010). *Quantum computers*. Nature.
5. Häffner, H., Roos, C. F., & Blatt, R. (2008). *Quantum computing with trapped ions*. Physics Reports.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Quantum Control and Measurement

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Understand quantum control principles and techniques
2. Analyze measurement theory and readout mechanisms
3. Study pulse shaping and feedback control
4. Evaluate control fidelity and measurement accuracy
5. Prepare for practical quantum system operation

Course Outcomes
CO1: Explain quantum control fundamentals
CO2: Design basic control pulse schemes
CO3: Analyze quantum measurement processes
CO4: Evaluate control and readout fidelity
CO5: Apply control concepts to quantum hardware

Detailed Syllabus

Unit I
Quantum control fundamentals; system Hamiltonians; control fields; open loop and closed loop control; controllability concepts; engineering relevance for manipulating quantum states.

Unit II
Pulse shaping; microwave and laser pulses; amplitude and phase modulation; optimal control basics; robustness considerations; mitigation of control induced errors.

Unit III
Quantum measurement theory; projective measurements; weak measurements; measurement back action; readout mechanisms; information extraction from quantum systems.

Unit IV
Feedback and adaptive control; real time measurement based control; stabilization of quantum states; error suppression; engineering challenges in fast control loops.

Unit V
Control fidelity; calibration; noise effects; benchmarking techniques; scalability challenges; integration of control and measurement in large quantum systems.

Text Books

1. Wiseman, H. M., & Milburn, G. J. (2010). *Quantum measurement and control*. Cambridge University Press.
2. Brif, C., Chakrabarti, R., & Rabitz, H. (2010). *Control of quantum phenomena*. New Journal of Physics.
3. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
4. D'Alessandro, D. (2008). *Introduction to quantum control and dynamics*. CRC Press.
5. Clerk, A. A., et al. (2010). *Introduction to quantum noise*. Reviews of Modern Physics.

Reference Books

1. Khaneja, N., et al. (2005). *Optimal control of coupled spin dynamics*. Physical Review A.
2. Gambetta, J. M., et al. (2012). *Characterization of addressability by simultaneous randomized benchmarking*. Physical Review Letters.
3. Preskill, J. (2018). *Lecture notes on quantum computation*. Caltech.
4. Jacobs, K. (2014). *Quantum measurement theory and its applications*. Cambridge University Press.
5. Steck, D. A. (2019). *Quantum and atom optics*. Available lecture notes.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective II (Quantum Optimization / Quantum Finance)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide advanced specialization in applied quantum domains
2. Introduce optimization or financial modeling using quantum methods
3. Analyze problem formulations suitable for quantum advantage
4. Apply algorithms to real world case studies
5. Prepare for industry and research oriented roles

Course Outcomes
CO1: Understand fundamentals of selected specialization
CO2: Formulate problems for quantum optimization or finance
CO3: Apply relevant quantum algorithms
CO4: Analyze solution quality and limitations
CO5: Relate specialization knowledge to practical applications

Detailed Syllabus

Unit I
Foundations of selected elective; optimization or financial modeling basics; problem classes; constraints; objective functions; relevance of quantum approaches in applied domains.

Unit II
Problem encoding; Ising models; QUBO formulations; Hamiltonian representation; mapping classical problems to quantum frameworks.

Unit III
Algorithms; variational approaches; quantum annealing concepts; hybrid workflows; performance considerations; practical implementation aspects.

Unit IV
Application case studies; portfolio optimization or combinatorial optimization; result interpretation; comparison with classical methods.

Unit V
Limitations; noise sensitivity; scalability; ethical and economic considerations; future prospects; industry relevance of quantum optimization or finance.

Text Books

1. Lucas, A. (2014). *Ising formulations of many NP problems*. Frontiers in Physics.
2. Orús, R., Mugel, S., & Lizaso, E. (2019). *Quantum computing for finance*. Reviews in Physics.
3. Hidary, J. D. (2019). *Quantum computing: An applied approach*. Springer.
4. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
5. McGeoch, C. (2014). *Adiabatic quantum computation and quantum annealing*. Synthesis Lectures.

Reference Books

1. Schuld, M., & Petruccione, F. (2018). *Supervised learning with quantum computers*. Springer.
2. Preskill, J. (2018). *Quantum computing in the NISQ era*. Quantum.

3. Venturelli, D., et al. (2015). *Quantum optimization of fully connected spin glasses*. Physical Review X.
4. Woerner, S., & Egger, D. J. (2019). *Quantum risk analysis*. NPJ Quantum Information.
5. Montanaro, A. (2016). *Quantum algorithms: An overview*. NPJ Quantum Information.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective III (Photonics / Advanced Materials for Qubits)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce photonic or material platforms for qubits
2. Study physical properties enabling quantum coherence
3. Analyze fabrication and integration challenges
4. Evaluate performance metrics of material platforms
5. Prepare for hardware oriented specialization

Course Outcomes
CO1: Explain principles of photonic or material based qubits
CO2: Analyze coherence and loss mechanisms
CO3: Understand fabrication and integration processes
CO4: Evaluate suitability of materials for qubits
CO5: Relate material properties to quantum performance

Detailed Syllabus

Unit I
Foundations of selected elective; photonic or material platforms; physical principles; interaction mechanisms; relevance to quantum information processing hardware.

Unit II
Photonic qubits or material systems; sources; waveguides; defects; color centers; control and manipulation techniques.

Unit III
Fabrication techniques; nanofabrication; material growth; integration challenges; reproducibility; scalability considerations.

Unit IV
Decoherence and loss mechanisms; material defects; noise sources; mitigation strategies; performance optimization.

Unit V
Applications; scalability prospects; hybrid platforms; future research directions; engineering challenges in photonic or material based quantum systems.

Text Books

1. O'Brien, J. L., Furusawa, A., & Vučković, J. (2009). *Photonic quantum technologies*. Nature Photonics.
2. Awschalom, D. D., Hanson, R., Wrachtrup, J., & Zhou, B. B. (2018). *Quantum technologies with optically interfaced solid state spins*. Nature Photonics.
3. Fox, M. (2010). *Quantum optics*. Oxford University Press.
4. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
5. Sze, S. M., & Ng, K. K. (2017). *Physics of semiconductor devices*. Wiley.

Reference Books

1. Gerry, C. C., & Knight, P. L. (2005). *Introductory quantum optics*. Cambridge University Press.
2. Yamamoto, Y., & Imamoglu, A. (1999). *Mesoscopic quantum optics*. Wiley.
3. Hanson, R., et al. (2008). *Spins in few electron quantum dots*. Reviews of Modern Physics.
4. Atatüre, M., Englund, D., Vamivakas, N., Lee, S. Y., & Wrachtrup, J. (2018). *Material platforms for spin based photonic quantum technologies*. Nature Reviews Materials.
5. Poole, C. P. (2010). *Electron spin resonance*. Dover Publications.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Emerging Trends in Quantum Technologies

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Survey emerging quantum technologies and applications
2. Analyze recent research and industrial developments
3. Understand interdisciplinary convergence in quantum field
4. Evaluate societal, ethical, and policy implications
5. Prepare for lifelong learning in quantum technologies

Course Outcomes
CO1: Identify emerging quantum technology trends
CO2: Analyze recent research and industrial progress
CO3: Understand interdisciplinary applications
CO4: Evaluate ethical and societal implications
CO5: Communicate insights on future quantum directions

Detailed Syllabus

Unit I
Overview of quantum technology landscape; sensing; metrology; computing; communication; industrial ecosystem; relevance to national and global technology initiatives.

Unit II
Quantum sensing and metrology; precision measurement; applications; material and device considerations; engineering impact in science and industry.

Unit III
Hybrid quantum systems; integration with classical systems; cloud based quantum services; software stacks; practical deployment considerations.

Unit IV
Standardization; benchmarking; roadmaps; policy frameworks; intellectual property; workforce development; engineering relevance.

Unit V
Ethical, societal, and security implications; workforce skills; future outlook; sustainability; interdisciplinary collaboration in advancing quantum technologies.

Text Books

1. Dowling, J. P., & Milburn, G. J. (2003). *Quantum technology: The second quantum revolution*. Philosophical Transactions.
2. Nielsen, M. A., & Chuang, I. L. (2019). *Quantum computation and quantum information*. Cambridge University Press.
3. Acín, A., et al. (2018). *The quantum technologies roadmap*. New Journal of Physics.
4. Preskill, J. (2018). *Quantum computing in the NISQ era*. Quantum.
5. Fox, M. (2010). *Quantum optics*. Oxford University Press.

Reference Books

1. Giovannetti, V., Lloyd, S., & Maccone, L. (2011). *Advances in quantum metrology*. Nature Photonics.
2. Degen, C. L., Reinhard, F., & Cappellaro, P. (2017). *Quantum sensing*. Reviews of Modern Physics.
3. National Academies of Sciences. (2019). *Quantum computing: Progress and prospects*. National Academies Press.
4. Arute, F., et al. (2019). *Quantum supremacy using a programmable superconducting processor*. Nature.
5. Biamonte, J., et al. (2017). *Quantum machine learning*. Nature.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship (Industry / Research Lab)

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Provide extended industry or research immersion
2. Apply academic knowledge in professional environments
3. Develop advanced technical and professional skills
4. Understand organizational practices and ethics
5. Prepare for major project execution

Course Outcomes
CO1: Demonstrate professional competence in workplace
CO2: Apply theoretical knowledge to practical tasks
CO3: Exhibit ethical and professional behavior
CO4: Document technical activities systematically
CO5: Present internship outcomes effectively

Guidelines
Full SEMESTER attachment; defined learning objectives; periodic faculty review; industry or lab mentor feedback; report submission and presentation.

Evaluation Scheme
Continuous Assessment (100%)

Major Project Phase I

Course Category
Project Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Identify major project problem and scope
2. Conduct literature survey and requirement analysis
3. Define methodology and project plan
4. Initiate preliminary design and experimentation
5. Prepare for full scale project execution

Course Outcomes
CO1: Define a relevant project problem statement
CO2: Conduct structured literature review
CO3: Develop project methodology and plan
CO4: Demonstrate preliminary design or results
CO5: Prepare formal project documentation

Guidelines
Problem identification; literature review; methodology definition; milestones; preliminary results; proposal documentation; periodic evaluation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VIII

Intellectual Property Rights and Technology Entrepreneurship

Course Category
Humanities and Management Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamentals of intellectual property systems
2. Develop awareness of patents, copyrights, trademarks, and designs
3. Analyze technology commercialization and entrepreneurship models
4. Promote innovation driven enterprise creation
5. Build legal and managerial awareness for technology ventures

Course Outcomes
CO1: Identify different forms of intellectual property
CO2: Apply patent search and filing concepts
CO3: Understand technology transfer mechanisms
CO4: Analyze entrepreneurship and startup ecosystems
CO5: Integrate IP strategy with technology innovation

Detailed Syllabus

Unit I
Intellectual property concepts; evolution; need for protection; types of intellectual property; patents, copyrights, trademarks, industrial designs; global and Indian IP frameworks; relevance to technology driven innovation.

Unit II
Patent fundamentals; patentability criteria; prior art search; patent specification; filing procedures; patent examination; grant and opposition; technology relevance in engineering and scientific inventions.

Unit III
Copyrights and trademarks; scope; registration; infringement; geographical indications; trade secrets; management of intellectual assets in technology enterprises.

Unit IV
Technology transfer; licensing; commercialization models; university industry interaction; startup incubation; funding mechanisms; role of IP in entrepreneurship development.

Unit V
Entrepreneurship concepts; business models; innovation management; startup lifecycle; regulatory environment; ethics; sustainability; integration of IP strategy with technology business planning.

Text Books

1. Ganguli, P. (2017). *Intellectual property rights*. Tata McGraw-Hill.
2. WIPO. (2016). *Intellectual property handbook*. World Intellectual Property Organization.
3. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2018). *Entrepreneurship*. McGraw-Hill.
4. Kuratko, D. F. (2017). *Entrepreneurship: Theory, process, practice*. Cengage.
5. Pressman, D. (2019). *Patent it yourself*. Nolo.

Reference Books

1. Cornish, W., Llewelyn, D., & Aplin, T. (2019). *Intellectual property*. Sweet and Maxwell.
2. Bansal, R. K. (2018). *Entrepreneurship development*. New Age International.
3. Tidd, J., & Bessant, J. (2020). *Managing innovation*. Wiley.
4. Maskus, K. E. (2017). *Intellectual property rights in the global economy*. Peterson Institute.
5. Aulet, B. (2017). *Disciplined entrepreneurship*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project Phase II (Industry / Research Based)

Course Category
Project Course

Credits / Contact Hours
10 Credits / 150 Contact Hours

Course Objectives

1. Execute major project based on defined methodology
2. Apply advanced technical knowledge to real problems
3. Conduct experimentation, simulation, or system development

4. Demonstrate innovation, analysis, and implementation skills
5. Prepare comprehensive technical documentation

Course Outcomes
CO1: Implement complete project solution
CO2: Analyze results and validate objectives
CO3: Apply engineering tools and methodologies
CO4: Demonstrate independent research or development capability
CO5: Present and defend project outcomes

Guidelines
Problem execution; design and development; experimentation or simulation; performance evaluation; documentation; periodic review; final dissertation and presentation.

Evaluation Scheme
Continuous Assessment (100%)

Open Elective III (Interdisciplinary)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide interdisciplinary academic exposure
2. Enable integration of knowledge across domains
3. Encourage flexible learning and innovation
4. Support emerging and cross disciplinary interests
5. Enhance employability and higher study readiness

Course Outcomes
CO1: Understand fundamentals of selected interdisciplinary domain
CO2: Apply interdisciplinary concepts to problem solving
CO3: Analyze integration of multiple knowledge areas
CO4: Develop adaptable learning skills
CO5: Relate elective learning to professional growth

Detailed Syllabus

Unit I
Foundational concepts of selected interdisciplinary area; scope; terminology; application domains; relevance to engineering and societal challenges.

Unit II
Core methods and tools; models; frameworks; implementation approaches; interdisciplinary integration techniques.

Unit III
Data, systems, or processes; performance considerations; constraints; application case studies across disciplines.

Unit IV
Advanced topics; recent research trends; industrial relevance; innovation opportunities.

Unit V
Ethical, societal, and sustainability considerations; future directions; interdisciplinary collaboration and impact.

Text Books

1. Standard textbook relevant to selected interdisciplinary elective.
2. Domain specific academic reference book.
3. Authoritative professional publication.
4. University level reference text.
5. Recognized interdisciplinary source.

Reference Books

1. Recent academic reference in interdisciplinary domain.
2. Professional handbook or guide.
3. Standards or policy documentation.
4. Advanced topic reference material.
5. Supplementary reading resources.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Seminar / Viva-Voce / Portfolio

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop technical presentation and communication skills
2. Assess comprehensive understanding of program outcomes
3. Encourage reflective learning and portfolio development
4. Evaluate professional readiness and subject mastery
5. Prepare for transition to industry or higher studies

Course Outcomes
CO1: Present technical content effectively
CO2: Demonstrate integrated program knowledge
CO3: Defend technical and academic work confidently
CO4: Compile and present professional portfolio
CO5: Exhibit professional ethics and communication competence

Guidelines
Seminar topic selection; literature survey; technical presentation; viva voce examination; portfolio compilation; evaluation by departmental committee.

Evaluation Scheme
Continuous Assessment (100%)

B.Sc. – Artificial Intelligence & Data Analytics

Duration: 3 Years | 6 Semesters | Total Credits: 120

SEMESTER I

Mathematics I (Calculus & Linear Algebra)

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical foundations for engineering and data analytics applications
2. Strengthen analytical skills in calculus and matrix theory
3. Enable formulation of real world problems using mathematical models
4. Build competence in linear systems and vector spaces
5. Support higher level courses in AI and data science

Course Outcomes
CO1 – Apply limits, continuity, and differentiation in problem solving
CO2 – Solve optimization problems using differential calculus
CO3 – Analyze functions using integration techniques
CO4 – Apply matrix algebra in solving linear systems
CO5 – Use vector spaces and eigen concepts in data analytics contexts

Detailed Syllabus

Unit I
Functions, limits, continuity; algebra of limits, standard limits; differentiability, geometric interpretation; higher order derivatives; applications in engineering problems; rate of change, related rates; mathematical modeling of simple systems, analytical interpretation, computational relevance.

Unit II
Applications of differentiation; Taylor and Maclaurin series expansions; maxima and minima of functions; curvature, radius of curvature; points of inflection; optimization problems in engineering and analytics; approximation techniques; numerical relevance, computational efficiency considerations.

Unit III
Indefinite integrals, standard integrals; methods of integration, substitution, partial fractions; definite integrals, properties; applications to area, volumes; mean value theorems; engineering interpretations; integral based modeling, analytical computation relevance.

Unit IV
Matrices and determinants; types of matrices; rank of matrices; solution of linear equations using Gaussian elimination; inverse matrices; consistency of linear systems; applications in engineering and data modeling; computational representation, numerical stability considerations.

Unit V
Vector spaces, subspaces; linear independence, basis, dimension; eigenvalues and eigenvectors; characteristic equations; diagonalization of matrices; applications in engineering systems, data transformation, dimensionality reduction concepts; analytical foundations for machine learning algorithms.

Text Books

1. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley.
2. Anton, H., & Rorres, C. (2014). *Elementary Linear Algebra* (11th ed.). Wiley.
3. Jain, R. K., & Iyengar, S. R. K. (2014). *Advanced Engineering Mathematics*. Narosa Publishing House.
4. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' Calculus* (14th ed.). Pearson.
5. Strang, G. (2016). *Introduction to Linear Algebra* (5th ed.). Wellesley-Cambridge Press.

Reference Books

1. Stewart, J. (2016). *Calculus: Early Transcendentals* (8th ed.). Cengage Learning.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2015). *Linear Algebra and Its Applications* (5th ed.). Pearson.
3. Simmons, G. F. (2016). *Differential Equations with Applications and Historical Notes*. CRC Press.
4. Rao, S. S. (2011). *Engineering Mathematics*. New Age International.
5. Boylestad, R. (2015). *Linear Algebra with Applications*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Introduction to Computer Systems

Course Category
Engineering Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Introduce fundamental computer system organization
2. Explain hardware and software interaction principles
3. Develop understanding of data representation and processing
4. Familiarize learners with operating system basics
5. Build foundation for advanced computing subjects

Course Outcomes
CO1 – Describe computer system components and architecture
CO2 – Explain data representation and number systems
CO3 – Analyze CPU organization and instruction execution
CO4 – Identify operating system functions and services
CO5 – Relate computer system concepts to programming environments

Detailed Syllabus

Unit I
Computer systems overview; evolution of computing; functional units; input output devices; system block diagram; hardware software interface; performance metrics; computing classifications; modern computing trends; foundational relevance to data analytics environments.

Unit II
Number systems; binary, octal, hexadecimal representations; conversions; fixed and floating point representation; character codes; error detection concepts; data representation techniques; computational accuracy; precision limitations; digital data handling fundamentals.

Unit III
Central processing unit organization; instruction cycle; registers; arithmetic logic unit; control unit; instruction formats; addressing modes; pipelining concepts; performance enhancement techniques; execution efficiency; computational throughput analysis.

Unit IV
Memory hierarchy; primary memory, cache memory; secondary storage devices; memory management basics; input output organization; interrupt handling; direct memory access; storage performance parameters; reliability considerations; system scalability concepts.

Unit V
Operating systems overview; process management; memory management; file systems; device management; system calls; booting process; virtualization concepts; system security basics; relevance to modern computing platforms and analytics systems.

Text Books

1. Stallings, W. (2019). *Computer Organization and Architecture* (11th ed.). Pearson.
2. Tanenbaum, A. S. (2016). *Structured Computer Organization* (6th ed.). Pearson.
3. Mano, M. M. (2017). *Computer System Architecture* (3rd ed.). Pearson.
4. Null, L., & Lobur, J. (2018). *The Essentials of Computer Organization and Architecture*. Jones & Bartlett.
5. Patterson, D. A., & Hennessy, J. L. (2021). *Computer Organization and Design*. Morgan Kaufmann.

Reference Books

1. Hamacher, V. C., Vranesic, Z. G., & Zaky, S. G. (2018). *Computer Organization*. McGraw-Hill.
2. Bryant, R. E., & O'Hallaron, D. R. (2016). *Computer Systems: A Programmer's Perspective*. Pearson.
3. Silberschatz, A., Galvin, P. B., & Gagne, G. (2018). *Operating System Concepts*. Wiley.
4. Carter, J. (2015). *Computer Architecture*. Oxford University Press.
5. Flynn, M. J., & Rudd, K. W. (2017). *Parallel Architectures*. Morgan Kaufmann.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Programming Fundamentals (Python)

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce structured programming concepts
2. Develop problem solving skills using Python
3. Familiarize learners with data types and control structures

4. Enable modular programming practices
5. Prepare students for advanced data analytics programming

Course Outcomes
CO1 – Write basic Python programs for problem solving
CO2 – Apply control structures and functions effectively
CO3 – Use built in data structures for data handling
CO4 – Implement modular and reusable code
CO5 – Relate programming constructs to data analytics applications

Detailed Syllabus

Unit I
Programming fundamentals; problem solving steps; algorithms, flowcharts; Python language features; syntax, keywords; variables, data types; input output statements; indentation rules; interactive execution; scripting concepts; programming environment setup.

Unit II
Operators and expressions; arithmetic, relational, logical operators; control structures; conditional statements; looping constructs; nested loops; iteration techniques; flow control statements; computational logic development; debugging basics.

Unit III
Functions; function definition and invocation; parameters, return values; scope of variables; recursion concepts; lambda expressions; modular programming; code reusability; documentation practices; performance considerations.

Unit IV
Built in data structures; lists, tuples, sets, dictionaries; operations and methods; slicing and indexing; data manipulation techniques; iteration over collections; memory representation; efficiency considerations; practical data handling.

Unit V
File handling; file modes; reading and writing files; exception handling; error types; basic object oriented concepts; classes, objects; simple use cases; relevance to data analytics workflows; program robustness principles.

Text Books

1. Lutz, M. (2013). *Learning Python* (5th ed.). O'Reilly Media.
2. Downey, A. B. (2016). *Think Python* (2nd ed.). O'Reilly Media.
3. Sweigart, A. (2019). *Automate the Boring Stuff with Python* (2nd ed.). No Starch Press.
4. Severance, C. R. (2016). *Python for Everybody*. Pearson.

5. Zelle, J. (2017). *Python Programming: An Introduction to Computer Science*. Franklin, Beedle & Associates.

Reference Books

1. Ramalho, L. (2015). *Fluent Python*. O'Reilly Media.
2. Hetland, M. L. (2017). *Beginning Python*. Apress.
3. Guttag, J. V. (2016). *Introduction to Computation and Programming Using Python*. MIT Press.
4. Perkovic, L. (2015). *Introduction to Computing Using Python*. Wiley.
5. Beazley, D. (2013). *Python Essential Reference*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Basics of Statistics for Data Analysis

Course Category
Basic Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce statistical foundations for data analysis
2. Develop understanding of descriptive statistics
3. Explain probability concepts and random variables
4. Enable application of statistical measures in data analytics
5. Support advanced statistical and machine learning courses

Course Outcomes
CO1 – Apply descriptive statistical measures to datasets
CO2 – Interpret probability concepts and distributions
CO3 – Analyze data variability and relationships
CO4 – Use statistical tools for data summarization
CO5 – Relate statistical concepts to analytics applications

Detailed Syllabus

Unit I
Statistics overview; data types; scales of measurement; data collection methods; population

and samples; descriptive statistics concepts; frequency distributions; graphical representations; analytical relevance; data summarization techniques.

Unit II
Measures of central tendency; mean, median, mode; measures of dispersion; range, variance, standard deviation; coefficient of variation; skewness, kurtosis; interpretation of data spread; analytical insights; computational aspects.

Unit III
Probability concepts; sample space; events; axioms of probability; addition and multiplication theorems; conditional probability; Bayes theorem; analytical reasoning; applications in data analytics and decision making.

Unit IV
Random variables; discrete and continuous variables; probability mass function; probability density function; expectation, variance; common distributions overview; analytical interpretation; relevance to data modeling and inference.

Unit V
Correlation and regression; covariance; Pearson correlation coefficient; simple linear regression; regression coefficients; goodness of fit; interpretation of relationships; predictive relevance; analytics based decision support concepts.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and Statistics for Engineers and Scientists* (9th ed.). Pearson.
2. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*. Cengage Learning.
3. Levine, D. M., Stephan, D. F., & Szabat, K. A. (2017). *Statistics for Managers Using Microsoft Excel*. Pearson.
4. Gupta, S. C., & Kapoor, V. K. (2014). *Fundamentals of Mathematical Statistics*. Sultan Chand.
5. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.

Reference Books

1. Ross, S. M. (2014). *Introduction to Probability and Statistics for Engineers and Scientists*. Academic Press.
2. Freund, J. E. (2015). *Mathematical Statistics*. Pearson.
3. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2018). *Probability and Statistical Inference*. Pearson.

4. Spiegel, M. R., Schiller, J. J., & Srinivasan, R. A. (2014). *Schaum's Outline of Statistics*. McGraw-Hill.
5. Anderson, D. R., Sweeney, D. J., & Williams, T. A. (2016). *Statistics for Business and Economics*. Cengage.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Logic & Computing Fundamentals

Course Category
Engineering Science Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce digital logic principles
2. Develop understanding of Boolean algebra
3. Explain combinational and sequential circuits
4. Relate digital logic to computing systems
5. Prepare foundation for hardware oriented courses

Course Outcomes
CO1 – Apply number systems and Boolean algebra
CO2 – Design basic combinational logic circuits
CO3 – Analyze sequential logic elements
CO4 – Understand digital system building blocks
CO5 – Relate logic design concepts to computing applications

Detailed Syllabus

Unit I
Digital systems overview; number systems; binary arithmetic; signed number representation; codes; Boolean algebra; logic gates; truth tables; logic simplification techniques; computational relevance; hardware abstraction concepts.

Unit II
Combinational logic circuits; Boolean function representation; Karnaugh maps; minimization techniques; arithmetic circuits; adders, subtractors; multiplexers, demultiplexers; encoders, decoders; design methodology; implementation considerations.

Unit III
Sequential logic concepts; latches and flip flops; timing diagrams; registers; counters; shift

registers; state tables; state diagrams; clocking principles; synchronization; digital control fundamentals.

Unit IV
Memory elements; ROM, RAM types; programmable logic devices; PLA, PAL; introduction to FPGA concepts; digital system integration; scalability; performance parameters; reliability considerations; computing system relevance.

Unit V
Introduction to digital computing blocks; data paths; control logic; arithmetic logic unit basics; simple processor model; hardware software interface; relevance to computer organization; analytics hardware acceleration awareness.

Text Books

1. Mano, M. M., & Ciletti, M. D. (2017). *Digital Design* (6th ed.). Pearson.
2. Floyd, T. L. (2015). *Digital Fundamentals* (11th ed.). Pearson.
3. Brown, S., & Vranesic, Z. (2014). *Fundamentals of Digital Logic with VHDL Design*. McGraw-Hill.
4. Wakerly, J. F. (2017). *Digital Design: Principles and Practices*. Pearson.
5. Roth, C. H., & Kinney, L. L. (2016). *Fundamentals of Logic Design*. Cengage.

Reference Books

1. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2014). *Digital Systems*. Pearson.
2. Morris, M. (2016). *Digital Design and Computer Architecture*. Morgan Kaufmann.
3. Salivahanan, S., Kumar, S. S., & Vallavaraj, A. (2011). *Digital Circuits and Design*. Tata McGraw-Hill.
4. Jain, R. P. (2013). *Modern Digital Electronics*. McGraw-Hill.
5. Parhami, B. (2010). *Computer Arithmetic*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Communication Skills & Professional English

Course Category
Humanities & Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Improve professional communication skills
2. Develop technical writing competence
3. Enhance presentation and interpersonal skills
4. Build confidence in professional interactions
5. Prepare learners for industry communication requirements

Course Outcomes
CO1 – Communicate effectively in professional contexts
CO2 – Demonstrate clarity in technical writing
CO3 – Apply verbal and non verbal communication skills
CO4 – Prepare structured professional documents
CO5 – Exhibit effective presentation and interview skills

Detailed Syllabus

Unit I
Communication process; types of communication; barriers; listening skills; professional etiquette; verbal communication principles; clarity and coherence; tone and style; workplace communication relevance.

Unit II
Technical writing fundamentals; sentence structure; paragraph organization; coherence techniques; reports, emails; formal correspondence; documentation standards; professional vocabulary; clarity and precision.

Unit III
Oral communication skills; presentations; speech organization; audience analysis; visual aids; articulation; body language; confidence building; professional interaction scenarios.

Unit IV
Interpersonal communication; group discussions; teamwork dynamics; conflict resolution; leadership communication; negotiation skills; professional ethics; cultural sensitivity; workplace relevance.

Unit V
Career communication; resume writing; interview skills; corporate communication;

professional grooming; digital communication etiquette; employability skills; lifelong learning orientation.

Text Books

1. Raman, M., & Sharma, S. (2018). *Technical Communication: Principles and Practice*. Oxford University Press.
2. Meenakshi, R., & Mishra, S. (2014). *Professional Communication*. Pearson.
3. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2016). *Business Communication*. McGraw-Hill.
4. Guffey, M. E., & Loewy, D. (2018). *Essentials of Business Communication*. Cengage.
5. Murphy, R. (2019). *English Grammar in Use*. Cambridge University Press.

Reference Books

1. Bovee, C. L., & Thill, J. V. (2017). *Business Communication Today*. Pearson.
2. Adler, R. B., Rodman, G., & du Pré, A. (2016). *Understanding Human Communication*. Oxford University Press.
3. McCornack, S. (2015). *Reflect and Relate*. Bedford/St. Martin's.
4. Lucas, S. E. (2015). *The Art of Public Speaking*. McGraw-Hill.
5. Jain, A. (2016). *Communication Skills*. Tata McGraw-Hill.

Evaluation Scheme
Continuous Assessment (50%) + End-Semester Examination (50%)

Computing Laboratory I

Course Category
Engineering Science Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Reinforce programming fundamentals through practice
2. Develop hands on skills in Python programming
3. Apply problem solving techniques in computing
4. Improve debugging and logical reasoning skills
5. Prepare learners for advanced programming laboratories

Course Outcomes
CO1 – Implement basic Python programs
CO2 – Apply control structures in practical problems
CO3 – Use data structures for computation
CO4 – Debug and test programs effectively
CO5 – Demonstrate disciplined laboratory practices

List of Experiments / Exercises

1. Write Python programs for basic input output operations, arithmetic calculations, and conditional execution using standard programming constructs, focusing on syntax correctness and logical flow development.
2. Develop programs using looping constructs to generate number patterns, series computations, and iterative problem solving tasks, emphasizing algorithmic thinking and control flow understanding.
3. Implement Python programs using functions for modular problem solving, parameter passing, and return values, focusing on code reusability and structured programming practices.
4. Design and execute programs using lists for data storage, traversal, insertion, deletion, and aggregation operations, emphasizing efficient data handling techniques.
5. Develop programs using tuples and sets to perform data organization tasks, uniqueness checks, and set operations, focusing on conceptual understanding of immutable and unordered collections.
6. Implement dictionary based programs for key value data management, lookup operations, and simple applications, emphasizing real world data representation skills.
7. Write Python programs for string manipulation tasks, including searching, formatting, slicing, and transformation operations, focusing on text data processing skills.
8. Develop file handling programs to read from and write to text files, handle data persistence, and manage file based input output operations effectively.
9. Implement exception handling mechanisms in Python programs to manage runtime errors, input validation, and program robustness, emphasizing defensive programming practices.
10. Develop simple class based Python programs demonstrating object oriented concepts, object creation, and method invocation, focusing on basic abstraction principles.

Expected Outcomes
Ability to design, implement, and debug Python programs using structured programming constructs, data structures, and basic object oriented concepts, demonstrating readiness for advanced programming and data analytics courses.

Evaluation Scheme
Continuous Assessment (60%) + End-Semester Practical Examination (40%)

SEMESTER II

Mathematics II (Probability & Distributions)

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Build probabilistic foundations for data analytics and AI
2. Develop understanding of random variables and distributions
3. Enable analytical reasoning under uncertainty
4. Apply probability models to engineering and data problems
5. Support advanced courses in statistics and machine learning

Course Outcomes
CO1 – Apply probability axioms and theorems to real problems
CO2 – Analyze discrete and continuous random variables
CO3 – Use standard probability distributions for modeling
CO4 – Compute expectation and variance measures
CO5 – Relate probabilistic concepts to data analytics applications

Detailed Syllabus

Unit I
Probability fundamentals; sample space, events; axioms of probability; addition and multiplication laws; conditional probability; independence of events; Bayes theorem; analytical interpretation; uncertainty modeling; relevance to data driven decision systems.

Unit II
Random variables; discrete and continuous variables; probability mass functions; probability density functions; cumulative distribution functions; expectation, variance; moments; transformation of variables; analytical significance; computational interpretation in analytics.

Unit III
Discrete probability distributions; Bernoulli, binomial, geometric distributions; Poisson distribution; mean and variance properties; distribution fitting; modeling of count data; applications in engineering systems; analytical relevance to real datasets.

Unit IV
Continuous probability distributions; uniform, exponential distributions; normal distribution; standard normal variable; properties and applications; probability calculations; distribution fitting; analytical relevance; modeling of continuous data phenomena.

Unit V
Joint distributions; joint probability functions; marginal and conditional distributions; covariance and correlation; independence concepts; distribution of sums; applications in analytics modeling; multivariate data interpretation foundations.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and Statistics for Engineers and Scientists* (9th ed.). Pearson.
2. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*. Cengage Learning.
3. Ross, S. M. (2014). *A First Course in Probability* (9th ed.). Pearson.
4. Gupta, S. C., & Kapoor, V. K. (2014). *Fundamentals of Mathematical Statistics*. Sultan Chand.
5. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.

Reference Books

1. Freund, J. E. (2015). *Mathematical Statistics*. Pearson.
2. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2018). *Probability and Statistical Inference*. Pearson.
3. Spiegel, M. R., Schiller, J. J., & Srinivasan, R. A. (2014). *Schaum's Outline of Probability and Statistics*. McGraw-Hill.
4. Anderson, D. R., Sweeney, D. J., & Williams, T. A. (2016). *Statistics for Business and Economics*. Cengage.
5. Johnson, R. A., & Bhattacharyya, G. K. (2019). *Statistics: Principles and Methods*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Data Structures & Algorithms

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Develop systematic problem solving using data structures

2. Introduce algorithmic design and analysis principles
3. Enable efficient data organization and manipulation
4. Build foundations for advanced computing and AI courses
5. Improve computational thinking and logical reasoning

Course Outcomes
CO1 – Select appropriate data structures for problem contexts
CO2 – Implement linear and non linear data structures
CO3 – Analyze algorithm efficiency using complexity measures
CO4 – Apply searching and sorting techniques
CO5 – Relate data structures to real world analytics problems

Detailed Syllabus

Unit I
Data structures overview; abstract data types; algorithm concepts; time and space complexity; asymptotic notations; performance analysis; programming environment considerations; data organization fundamentals; computational efficiency relevance.

Unit II
Linear data structures; arrays, linked lists; stacks, queues; operations and applications; memory representation; implementation techniques; traversal methods; algorithmic efficiency; practical problem solving relevance.

Unit III
Non linear data structures; trees; binary trees; binary search trees; tree traversals; heap structures; priority queues; applications in searching and scheduling; analytical relevance to hierarchical data.

Unit IV
Graph data structures; graph representations; traversal techniques; breadth first search; depth first search; shortest path concepts; spanning trees; applications in networks and analytics systems.

Unit V
Sorting and searching algorithms; linear and binary search; bubble, selection, insertion sort; merge and quick sort; algorithm comparison; efficiency considerations; application relevance to large data processing.

Text Books

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). *Introduction to Algorithms* (4th ed.). MIT Press.
2. Weiss, M. A. (2014). *Data Structures and Algorithm Analysis in Java*. Pearson.
3. Sahni, S. (2015). *Data Structures, Algorithms, and Applications*. McGraw-Hill.

4. Goodrich, M. T., Tamassia, R., & Goldwasser, M. H. (2014). *Data Structures and Algorithms in Python*. Wiley.
5. Horowitz, E., Sahni, S., & Anderson-Freed, S. (2013). *Fundamentals of Data Structures in C*. Universities Press.

Reference Books

1. Sedgewick, R., & Wayne, K. (2011). *Algorithms* (4th ed.). Addison-Wesley.
2. Kleinberg, J., & Tardos, É. (2006). *Algorithm Design*. Pearson.
3. Laaksonen, A. (2020). *Competitive Programmer's Handbook*. Springer.
4. Aho, A. V., Hopcroft, J. E., & Ullman, J. D. (2014). *Data Structures and Algorithms*. Pearson.
5. Brassard, G., & Bratley, P. (2011). *Fundamentals of Algorithmics*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Database Management Systems

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce database concepts and architectures
2. Develop data modeling and relational design skills
3. Enable structured query formulation
4. Explain transaction management and integrity concepts
5. Support data intensive application development

Course Outcomes
CO1 – Explain database system architecture and components
CO2 – Design relational database schemas
CO3 – Write SQL queries for data manipulation
CO4 – Apply normalization principles
CO5 – Understand transaction and concurrency concepts

Detailed Syllabus

Unit I
Database concepts; data models; database system architecture; file based systems limitations; DBMS advantages; users and administrators; database environment; application relevance; data management fundamentals.

Unit II
Entity relationship modeling; entities, attributes; relationships; constraints; ER diagrams; mapping to relational model; design methodology; schema representation; analytical relevance.

Unit III
Relational model; relational algebra concepts; integrity constraints; SQL overview; data definition language; data manipulation language; query formulation; aggregate functions; analytical querying relevance.

Unit IV
Normalization concepts; functional dependencies; normal forms; schema decomposition; lossless join; dependency preservation; design considerations; database efficiency; redundancy control relevance.

Unit V
Transaction management; ACID properties; concurrency control; locking mechanisms; recovery techniques; database security basics; authorization; backup strategies; enterprise data management relevance.

Text Books

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2019). *Database System Concepts* (7th ed.). McGraw-Hill.
2. Elmasri, R., & Navathe, S. B. (2016). *Fundamentals of Database Systems* (7th ed.). Pearson.
3. Ramakrishnan, R., & Gehrke, J. (2003). *Database Management Systems* (3rd ed.). McGraw-Hill.
4. Coronel, C., & Morris, S. (2019). *Database Systems: Design, Implementation, and Management*. Cengage.
5. Connolly, T., & Begg, C. (2015). *Database Systems*. Pearson.

Reference Books

1. Date, C. J. (2019). *An Introduction to Database Systems*. Pearson.
2. Garcia-Molina, H., Ullman, J. D., & Widom, J. (2009). *Database Systems: The Complete Book*. Pearson.
3. Atzeni, P., Ceri, S., Paraboschi, S., & Torlone, R. (2011). *Database Systems*. McGraw-Hill.

4. Rob, P., & Coronel, C. (2013). *Database Systems: Design, Implementation, and Management*. Cengage.
5. Kroenke, D. M., & Auer, D. J. (2015). *Database Concepts*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Exploratory Data Analysis

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce exploratory analysis of datasets
2. Develop data summarization and visualization skills
3. Identify patterns and anomalies in data
4. Support data driven reasoning processes
5. Prepare foundation for machine learning workflows

Course Outcomes
CO1 – Perform exploratory analysis on datasets
CO2 – Apply statistical summaries and visual tools
CO3 – Identify trends, patterns, and outliers
CO4 – Interpret data characteristics effectively
CO5 – Support analytical decision making

Detailed Syllabus

Unit I
Data understanding concepts; data types; data quality issues; missing values; outlier identification; data preprocessing overview; exploratory analysis objectives; analytical relevance; structured data inspection techniques.

Unit II
Descriptive statistics review; central tendency; dispersion measures; distribution shape; skewness; kurtosis; summary tables; analytical interpretation; relevance to dataset characterization.

Unit III
Data visualization principles; graphical perception; univariate plots; histograms; box plots; bar charts; design considerations; interpretability; analytical insight extraction techniques.

Unit IV
Bivariate analysis; scatter plots; correlation analysis; grouped summaries; conditional distributions; visualization techniques; relationship interpretation; analytical reasoning foundations.

Unit V
Multivariate exploration; pair plots; heat maps; dimensionality considerations; feature relationships; exploratory reporting; communication of findings; relevance to predictive modeling preparation.

Text Books

1. Tukey, J. W. (1977). *Exploratory Data Analysis*. Addison-Wesley.
2. De Veaux, R. D., Velleman, P. F., & Bock, D. E. (2018). *Intro Stats*. Pearson.
3. Cleveland, W. S. (1994). *The Elements of Graphing Data*. Hobart Press.
4. Wickham, H., & Grolemund, G. (2017). *R for Data Science*. O'Reilly Media.
5. Jolliffe, I. T. (2016). *Principal Component Analysis*. Springer.

Reference Books

1. Chambers, J. M., Cleveland, W. S., Kleiner, B., & Tukey, P. A. (2017). *Graphical Methods for Data Analysis*. CRC Press.
2. Few, S. (2012). *Show Me the Numbers*. Analytics Press.
3. Wilke, C. O. (2019). *Fundamentals of Data Visualization*. O'Reilly Media.
4. Everitt, B. S., & Hothorn, T. (2011). *An Introduction to Applied Multivariate Analysis*. Springer.
5. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Introduction to Artificial Intelligence

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce foundations and scope of artificial intelligence

2. Develop understanding of intelligent agents
3. Explain problem solving and search strategies
4. Introduce knowledge representation concepts
5. Prepare foundation for advanced AI courses

Course Outcomes
CO1 – Explain basic concepts and history of AI
CO2 – Analyze intelligent agent architectures
CO3 – Apply search techniques to problem solving
CO4 – Understand knowledge representation approaches
CO5 – Relate AI concepts to real world applications

Detailed Syllabus

Unit I
Artificial intelligence overview; historical evolution; intelligent systems; AI applications; interdisciplinary nature; ethical considerations; AI problem characteristics; relevance to data analytics ecosystems.

Unit II
Intelligent agents; agent types; environments; performance measures; rationality; agent architectures; autonomy; learning aspects; practical relevance to AI systems.

Unit III
Problem solving concepts; state space representation; uninformed search strategies; informed search strategies; heuristic functions; performance evaluation; computational considerations; applicability to optimization tasks.

Unit IV
Knowledge representation; propositional logic; predicate logic; inference mechanisms; rule based systems; reasoning under uncertainty; symbolic AI foundations; analytical significance.

Unit V
Introduction to machine learning concepts; learning paradigms; supervised, unsupervised learning; reinforcement learning overview; AI system lifecycle; future directions; application relevance.

Text Books

1. Russell, S. J., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
2. Poole, D. L., & Mackworth, A. K. (2017). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge University Press.
3. Rich, E., Knight, K., & Nair, S. B. (2010). *Artificial Intelligence*. McGraw-Hill.

4. Luger, G. F. (2017). *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*. Pearson.
5. Nilsson, N. J. (2014). *Principles of Artificial Intelligence*. Morgan Kaufmann.

Reference Books

1. Winston, P. H. (2014). *Artificial Intelligence*. Addison-Wesley.
2. Charniak, E., & McDermott, D. (2016). *Introduction to Artificial Intelligence*. Pearson.
3. Russell, S. (2019). *Human Compatible*. Viking.
4. Boden, M. A. (2016). *AI: Its Nature and Future*. Oxford University Press.
5. Kaplan, J. (2016). *Artificial Intelligence: What Everyone Needs to Know*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation

Course Category
Humanities & Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Introduce design thinking principles
2. Develop creative problem solving skills
3. Encourage innovation oriented mindset
4. Enable user centered solution development
5. Support interdisciplinary collaboration skills

Course Outcomes
CO1 – Apply design thinking stages effectively
CO2 – Identify user needs and problem contexts
CO3 – Generate creative solution alternatives
CO4 – Develop prototypes and evaluate solutions
CO5 – Demonstrate innovation oriented thinking

Detailed Syllabus

Unit I
Design thinking overview; innovation concepts; problem identification; user centric perspective; empathy mapping; creativity foundations; relevance to engineering problem solving.

Unit II
Problem definition; ideation techniques; brainstorming; mind mapping; creative frameworks; idea evaluation; feasibility considerations; innovation relevance.

Unit III
Concept development; prototyping methods; low fidelity prototypes; iterative refinement; feedback integration; analytical evaluation; design validation principles.

Unit IV
Innovation management; design constraints; sustainability considerations; ethical design; interdisciplinary collaboration; communication of ideas; implementation awareness.

Unit V
Entrepreneurial mindset; innovation ecosystems; case studies; design applications; intellectual property basics; future innovation trends; professional relevance.

Text Books

1. Brown, T. (2009). *Change by Design*. Harper Business.
2. Liedtka, J., King, A., & Bennett, K. (2013). *Solving Problems with Design Thinking*. Columbia University Press.
3. Kelley, T., & Kelley, D. (2013). *Creative Confidence*. Crown Business.
4. Kumar, V. (2012). *101 Design Methods*. Wiley.
5. Johansson-Sköldberg, U., Woodilla, J., & Çetinkaya, M. (2013). *Design Thinking*. Creativity and Innovation Management.

Reference Books

1. Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation*. Wiley.
2. Martin, R. L. (2009). *The Design of Business*. Harvard Business Press.
3. Cross, N. (2011). *Design Thinking*. Berg.
4. IDEO. (2015). *The Field Guide to Human-Centered Design*. IDEO.
5. Norman, D. A. (2013). *The Design of Everyday Things*. Basic Books.

Evaluation Scheme
Continuous Assessment (50%) + End-Semester Examination (50%)

Internship / Industrial Orientation

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industrial environments
2. Familiarize learners with professional practices
3. Bridge academic learning with industry expectations
4. Develop observational and reporting skills
5. Encourage professional ethics and discipline

Course Outcomes
CO1 – Identify industrial organizational structures
CO2 – Observe real world computing practices
CO3 – Relate academic knowledge to industry operations
CO4 – Demonstrate professional conduct
CO5 – Prepare structured internship reports

Guidelines
Industry orientation through visits, short term attachment, expert interactions, or virtual industrial exposure; maintenance of activity log; submission of structured report; compliance with institutional guidelines.

Evaluation Scheme
Continuous Assessment and Report Evaluation (100%)

SEMESTER III

Statistical Inference & Hypothesis Testing

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Develop foundations of statistical inference for data analytics
2. Enable estimation of population parameters from sample data
3. Introduce hypothesis testing frameworks
4. Build analytical reasoning under uncertainty
5. Support advanced analytics and machine learning courses

Course Outcomes
CO1 – Apply sampling theory and distribution concepts
CO2 – Estimate parameters using statistical techniques
CO3 – Perform hypothesis testing for real datasets
CO4 – Interpret confidence intervals and test results
CO5 – Relate inference methods to analytics applications

Detailed Syllabus

Unit I
Statistical inference concepts; population and samples; sampling methods; sampling distributions; central limit theorem; statistical estimation overview; bias, consistency; analytical interpretation; relevance to data driven decision making processes.

Unit II
Point estimation; properties of estimators; method of moments; maximum likelihood estimation; interval estimation concepts; confidence intervals for mean and variance; analytical interpretation; estimation accuracy considerations.

Unit III
Hypothesis testing fundamentals; null and alternative hypotheses; type I and type II errors; level of significance; critical regions; p value concept; test statistic formulation; analytical decision rules.

Unit IV
Parametric tests; z test, t test; tests for single mean, difference of means; tests for proportions; assumptions; analytical interpretation; applications in data analytics and experimental studies.

Unit V
Chi square tests; goodness of fit; test of independence; analysis of variance concepts; one way ANOVA; F test interpretation; analytical relevance; inference based decision support foundations.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and Statistics for Engineers and Scientists* (9th ed.). Pearson.
2. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*. Cengage Learning.
3. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.
4. Freund, J. E. (2015). *Mathematical Statistics*. Pearson.
5. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2018). *Probability and Statistical Inference*. Pearson.

Reference Books

1. Casella, G., & Berger, R. L. (2014). *Statistical Inference*. Cengage Learning.
2. Rao, C. R. (2014). *Linear Statistical Inference and Its Applications*. Wiley.
3. Lehmann, E. L., & Romano, J. P. (2015). *Testing Statistical Hypotheses*. Springer.
4. Mood, A. M., Graybill, F. A., & Boes, D. C. (2018). *Introduction to the Theory of Statistics*. McGraw-Hill.
5. Bain, L. J., & Engelhardt, M. (2017). *Introduction to Probability and Mathematical Statistics*. Cengage.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Machine Learning Fundamentals

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Introduce core concepts of machine learning
2. Develop understanding of supervised and unsupervised learning

3. Enable mathematical formulation of learning models
4. Explain model evaluation and validation techniques
5. Prepare foundation for advanced machine learning courses

Course Outcomes
CO1 – Explain machine learning paradigms and workflows
CO2 – Apply regression and classification techniques
CO3 – Use clustering methods for data analysis
CO4 – Evaluate models using appropriate metrics
CO5 – Relate learning algorithms to real world datasets

Detailed Syllabus

Unit I
Machine learning overview; learning paradigms; supervised, unsupervised learning; training and testing concepts; bias variance tradeoff; model complexity; learning workflows; relevance to data analytics systems.

Unit II
Regression techniques; linear regression; multiple regression; cost functions; gradient descent; regularization concepts; model assumptions; analytical interpretation; predictive modeling foundations.

Unit III
Classification methods; logistic regression; k nearest neighbors; decision trees; model assumptions; classification boundaries; performance metrics; analytical interpretation; practical relevance to analytics problems.

Unit IV
Unsupervised learning; clustering concepts; k means clustering; hierarchical clustering; distance measures; cluster evaluation; dimensionality considerations; analytical interpretation of grouping structures.

Unit V
Model evaluation; cross validation; confusion matrix; accuracy, precision, recall; overfitting and underfitting; model selection; deployment awareness; relevance to applied machine learning systems.

Text Books

1. Mitchell, T. M. (1997). *Machine Learning*. McGraw-Hill.
2. Alpaydin, E. (2020). *Introduction to Machine Learning* (4th ed.). MIT Press.
3. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
4. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning*. Springer.

5. Murphy, K. P. (2022). *Machine Learning: A Probabilistic Perspective*. MIT Press.

Reference Books

1. Hastie, T., Tibshirani, R., & Friedman, J. (2017). *The Elements of Statistical Learning*. Springer.
2. Shalev-Shwartz, S., & Ben-David, S. (2014). *Understanding Machine Learning*. Cambridge University Press.
3. Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2018). *Foundations of Machine Learning*. MIT Press.
4. Géron, A. (2022). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*. O'Reilly Media.
5. Kelleher, J. D., Mac Namee, B., & D'Arcy, A. (2020). *Fundamentals of Machine Learning for Predictive Data Analytics*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Data Warehousing & Data Mining

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce data warehousing architectures
2. Explain data integration and transformation processes
3. Develop understanding of data mining techniques
4. Enable pattern discovery from large datasets
5. Support business and analytical decision systems

Course Outcomes
CO1 – Explain data warehouse concepts and components
CO2 – Apply multidimensional data modeling
CO3 – Use association and classification techniques
CO4 – Perform clustering and pattern analysis
CO5 – Relate mining techniques to real analytics scenarios

Detailed Syllabus

Unit I
Data warehousing concepts; operational data stores; decision support systems; data warehouse architecture; components; metadata management; data integration relevance; analytical decision support foundations.

Unit II
Data warehouse design; dimensional modeling; star schema; snowflake schema; fact tables; dimension tables; data granularity; design considerations; analytical querying relevance.

Unit III
Data preprocessing; data cleaning; data transformation; data reduction; discretization; preparation techniques; analytical relevance; quality improvement foundations for mining processes.

Unit IV
Association rule mining; frequent itemsets; Apriori algorithm; support, confidence measures; pattern interpretation; applications in analytics; market basket analysis relevance.

Unit V
Classification and clustering; decision tree mining; naive Bayes concepts; k means clustering; cluster interpretation; analytical relevance; knowledge discovery foundations.

Text Books

1. Han, J., Kamber, M., & Pei, J. (2022). *Data Mining: Concepts and Techniques* (4th ed.). Morgan Kaufmann.
2. Inmon, W. H. (2005). *Building the Data Warehouse*. Wiley.
3. Kimball, R., & Ross, M. (2013). *The Data Warehouse Toolkit*. Wiley.
4. Tan, P. N., Steinbach, M., & Kumar, V. (2019). *Introduction to Data Mining*. Pearson.
5. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. (2016). *Data Mining: Practical Machine Learning Tools and Techniques*. Morgan Kaufmann.

Reference Books

1. Elmasri, R., & Navathe, S. B. (2016). *Fundamentals of Database Systems*. Pearson.
2. Piatetsky-Shapiro, G. (2014). *Knowledge Discovery in Databases*. AAAI Press.
3. Berry, M. J. A., & Linoff, G. S. (2011). *Data Mining Techniques*. Wiley.
4. Dunham, M. H. (2003). *Data Mining: Introductory and Advanced Topics*. Pearson.
5. Larose, D. T., & Larose, C. D. (2015). *Data Mining and Predictive Analytics*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Object-Oriented Programming

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce object oriented programming principles
2. Develop modular and reusable software design skills
3. Explain class based program structures
4. Enable abstraction and encapsulation techniques
5. Support large scale software development foundations

Course Outcomes
CO1 – Apply object oriented concepts in programming
CO2 – Design classes and object interactions
CO3 – Use inheritance and polymorphism effectively
CO4 – Implement exception handling mechanisms
CO5 – Relate OOP concepts to software system design

Detailed Syllabus

Unit I
Object oriented programming concepts; procedural versus object oriented approach; classes and objects; data abstraction; encapsulation principles; object interaction; software design relevance; programming paradigm foundations.

Unit II
Class design; constructors; access specifiers; instance variables; methods; object creation; memory management basics; coding standards; modular software development relevance.

Unit III
Inheritance concepts; single and multilevel inheritance; method overriding; polymorphism principles; dynamic binding; code reusability; extensibility considerations; software architecture relevance.

Unit IV
Interfaces and abstract classes; multiple inheritance concepts; packages; modular organization; exception handling; error types; robustness considerations; reliable software development foundations.

Unit V
File handling concepts; streams; object serialization; basic design patterns awareness; application development overview; relevance to enterprise and analytics software systems.

Text Books

1. Horstmann, C. S. (2019). *Core Java Volume I*. Pearson.
2. Deitel, P. J., & Deitel, H. M. (2017). *Java: How to Program*. Pearson.
3. Balagurusamy, E. (2014). *Object Oriented Programming with Java*. McGraw-Hill.
4. Schildt, H. (2018). *Java: The Complete Reference*. McGraw-Hill.
5. Booch, G. (2007). *Object-Oriented Analysis and Design*. Addison-Wesley.

Reference Books

1. Meyer, B. (2000). *Object-Oriented Software Construction*. Prentice Hall.
2. Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (2015). *Design Patterns*. Addison-Wesley.
3. Liskov, B., & Guttag, J. (2001). *Program Development in Java*. Addison-Wesley.
4. Freeman, E., & Robson, E. (2014). *Head First Design Patterns*. O'Reilly Media.
5. Martin, R. C. (2018). *Clean Architecture*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Data Visualization Techniques

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of data visualization
2. Develop skills for graphical representation of data
3. Enable effective communication of analytical insights
4. Explain visualization design considerations
5. Support data driven decision making

Course Outcomes
CO1 – Apply visualization principles to datasets
CO2 – Create appropriate charts and plots
CO3 – Interpret visual patterns and trends

CO4 – Design effective analytical dashboards
CO5 – Communicate insights through visual analytics

Detailed Syllabus

Unit I
Data visualization overview; role in analytics; data types and visual encoding; perception principles; visualization effectiveness; analytical communication relevance; exploratory and explanatory visualization foundations.

Unit II
Univariate visualization; bar charts; histograms; line plots; box plots; design considerations; scale selection; interpretability; analytical relevance to data summarization tasks.

Unit III
Bivariate visualization; scatter plots; correlation visualization; grouped bar charts; trend analysis; relationship interpretation; analytical reasoning foundations.

Unit IV
Multivariate visualization; heat maps; parallel coordinates; dimensionality considerations; color usage; layout principles; analytical insight extraction relevance.

Unit V
Dashboards and storytelling; interactive visualization concepts; visualization tools overview; reporting practices; ethical visualization; communication of insights; analytics decision support relevance.

Text Books

1. Few, S. (2012). *Show Me the Numbers*. Analytics Press.
2. Cairo, A. (2016). *The Truthful Art*. New Riders.
3. Cleveland, W. S. (1994). *The Elements of Graphing Data*. Hobart Press.
4. Wilke, C. O. (2019). *Fundamentals of Data Visualization*. O'Reilly Media.
5. Evergreen, S. (2017). *Effective Data Visualization*. SAGE.

Reference Books

1. Tufte, E. R. (2001). *The Visual Display of Quantitative Information*. Graphics Press.
2. Ware, C. (2021). *Information Visualization*. Morgan Kaufmann.
3. Knaflic, S. N. (2015). *Storytelling with Data*. Wiley.
4. Munzner, T. (2014). *Visualization Analysis and Design*. CRC Press.
5. Kirk, A. (2019). *Data Visualization*. SAGE.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Ethics / Indian Constitution)

Course Category
Humanities & Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Develop ethical awareness and social responsibility
2. Introduce constitutional values and civic duties
3. Promote professional ethics in technology practice
4. Encourage responsible citizenship
5. Support holistic student development

Course Outcomes
CO1 – Understand ethical principles and social values
CO2 – Interpret constitutional provisions and rights
CO3 – Apply ethics in professional decision making
CO4 – Recognize civic responsibilities
CO5 – Demonstrate responsible professional conduct

Detailed Syllabus

Unit I
Ethics concepts; moral philosophy basics; values and ethics; ethical dilemmas; relevance to professional practice; social responsibility foundations.

Unit II
Professional ethics; engineering ethics; codes of conduct; accountability; integrity; ethical decision frameworks; workplace relevance.

Unit III
Indian Constitution overview; historical background; fundamental rights; directive principles; constitutional values; democratic foundations.

Unit IV
Fundamental duties; governance structure; legislature, executive, judiciary; rule of law; citizenship concepts; civic responsibility relevance.

Unit V
Ethics in technology; data ethics; privacy issues; social impact of technology; sustainable development; responsible innovation awareness.

Text Books

1. Sharma, B. R. (2015). *Indian Constitution*. Laxmi Publications.

2. Subhash, K. C. (2016). *Ethics and Values*. Oxford University Press.
3. Velasquez, M. G. (2017). *Business Ethics*. Pearson.
4. Pylee, M. V. (2014). *India's Constitution*. S. Chand.
5. Boatright, J. R. (2016). *Ethics and the Conduct of Business*. Pearson.

Reference Books

1. Mahajan, V. D. (2014). *Constitutional Law of India*. Eastern Book Company.
2. Rawls, J. (2009). *A Theory of Justice*. Harvard University Press.
3. Harris, C. E., Pritchard, M. S., & Rabins, M. J. (2018). *Engineering Ethics*. Cengage.
4. Sandel, M. J. (2009). *Justice*. Harvard University Press.
5. Floridi, L. (2013). *The Ethics of Information*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (50%) + End-Semester Examination (50%)

Internship

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to real world industry environments
2. Strengthen application of analytics knowledge
3. Develop professional and communication skills
4. Encourage workplace ethics and discipline
5. Build readiness for advanced project work

Course Outcomes
CO1 – Apply academic knowledge in industry context
CO2 – Observe professional workflows and practices
CO3 – Demonstrate professional behavior and ethics
CO4 – Prepare structured technical reports
CO5 – Relate internship learning to academic curriculum

Guidelines
Industry attachment, project based internship, or research oriented internship under approved

supervision; maintenance of activity log; submission of internship report; presentation and evaluation as per institutional norms.

Evaluation Scheme
Continuous Assessment and Report Evaluation (100%)

SEMESTER IV

Deep Learning & Neural Networks

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Establish foundations of neural network based learning models
2. Enable mathematical understanding of deep learning architectures
3. Develop competence in training and optimization techniques
4. Introduce modern deep learning frameworks and applications
5. Prepare foundation for advanced AI specialization courses

Course Outcomes
CO1 – Explain neural network structures and learning mechanisms
CO2 – Apply gradient based optimization techniques
CO3 – Analyze deep learning architectures for applications
CO4 – Interpret performance metrics and training behavior
CO5 – Relate deep learning models to real world AI problems

Detailed Syllabus

Unit I
Neural networks fundamentals; biological inspiration; perceptron model; activation functions; network architectures; feedforward networks; learning paradigms; loss functions; analytical interpretation; relevance to modern artificial intelligence systems.

Unit II
Backpropagation algorithm; gradient descent variants; learning rate selection; optimization challenges; vanishing and exploding gradients; weight initialization strategies; convergence behavior; analytical performance considerations; computational efficiency aspects.

Unit III
Deep neural networks; multilayer architectures; regularization techniques; dropout; batch normalization; model capacity control; bias variance considerations; analytical interpretation; scalability relevance to large datasets.

Unit IV
Convolutional neural networks; convolution operations; pooling mechanisms; feature

extraction; architectural components; CNN variants overview; application domains; analytical relevance to image and pattern based data.

Unit V
Recurrent neural networks; sequence modeling; vanishing gradient issues; LSTM and GRU concepts; temporal data handling; application relevance; deep learning frameworks overview; deployment awareness in AI systems.

Text Books

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
2. Haykin, S. (2009). *Neural Networks and Learning Machines* (3rd ed.). Pearson.
3. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
4. Aggarwal, C. C. (2018). *Neural Networks and Deep Learning*. Springer.
5. Chollet, F. (2021). *Deep Learning with Python* (2nd ed.). Manning.

Reference Books

1. Nielsen, M. A. (2015). *Neural Networks and Deep Learning*. Determination Press.
2. Patterson, J., & Gibson, A. (2017). *Deep Learning*. O'Reilly Media.
3. Schmidhuber, J. (2015). *Deep Learning in Neural Networks*. Neural Networks.
4. Prince, S. J. D. (2023). *Understanding Deep Learning*. MIT Press.
5. Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2023). *Dive into Deep Learning*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Big Data Analytics

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce big data characteristics and architectures
2. Develop understanding of distributed data processing
3. Enable analysis of large scale datasets
4. Explain big data storage and computation models

5. Support analytics driven decision systems

Course Outcomes
CO1 – Explain big data concepts and ecosystem components
CO2 – Apply distributed storage and processing principles
CO3 – Analyze data using big data analytics frameworks
CO4 – Interpret scalability and performance issues
CO5 – Relate big data analytics to enterprise applications

Detailed Syllabus

Unit I
Big data concepts; volume velocity variety; data sources; challenges; big data ecosystem; analytics lifecycle; application domains; analytical relevance; transition from traditional to big data systems.

Unit II
Distributed file systems; HDFS architecture; data replication; fault tolerance; cluster concepts; scalability principles; storage efficiency; analytical relevance to large dataset management.

Unit III
MapReduce programming model; mapper and reducer concepts; execution flow; data locality; performance considerations; use cases; analytical interpretation; batch processing foundations.

Unit IV
Big data processing frameworks; Apache Spark overview; resilient distributed datasets; transformations and actions; in memory processing; performance benefits; analytical workload handling relevance.

Unit V
NoSQL databases; key value stores; column family stores; document databases; CAP theorem; consistency models; application scenarios; analytical relevance to big data driven systems.

Text Books

1. White, T. (2015). *Hadoop: The Definitive Guide*. O'Reilly Media.
2. Marz, N., & Warren, J. (2015). *Big Data: Principles and Best Practices*. Manning.
3. Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). *Learning Spark*. O'Reilly Media.
4. Leskovec, J., Rajaraman, A., & Ullman, J. D. (2020). *Mining of Massive Datasets*. Cambridge University Press.
5. Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big Data, Big Analytics*. Wiley.

Reference Books

1. Zikopoulos, P., Eaton, C., deRoos, D., Deutsch, T., & Lapis, G. (2012). *Understanding Big Data*. McGraw-Hill.
2. Sharda, R., Delen, D., & Turban, E. (2018). *Business Intelligence and Analytics*. Pearson.
3. Chen, M., Mao, S., & Liu, Y. (2014). *Big Data*. Mobile Networks and Applications.
4. Kleppmann, M. (2017). *Designing Data-Intensive Applications*. O'Reilly Media.
5. Sakr, S., & Gaber, M. M. (2014). *Large Scale and Big Data*. CRC Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Natural Language Processing

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce foundations of natural language processing
2. Develop understanding of text representation techniques
3. Enable computational analysis of language data
4. Explain language modeling and classification methods
5. Support AI applications involving textual data

Course Outcomes
CO1 – Explain NLP concepts and language processing pipeline
CO2 – Apply text preprocessing and representation techniques
CO3 – Analyze language models and classifiers
CO4 – Interpret performance of NLP systems
CO5 – Relate NLP techniques to real world applications

Detailed Syllabus

Unit I
Natural language processing overview; language challenges; NLP pipeline; text preprocessing; tokenization; normalization; stop words; stemming; analytical relevance; applications in intelligent systems.

Unit II
Text representation; bag of words; term frequency; inverse document frequency; n gram models; vector space representation; similarity measures; analytical interpretation; relevance to text analytics.

Unit III
Language modeling; probabilistic language models; n gram smoothing techniques; perplexity; sequence modeling foundations; analytical relevance; computational efficiency considerations.

Unit IV
Text classification; naive Bayes classifier; logistic regression for text; feature selection; sentiment analysis concepts; evaluation metrics; analytical interpretation; application relevance.

Unit V
Word embeddings; distributed representations; Word2Vec concepts; semantic similarity; contextual representations overview; NLP applications; future trends; relevance to modern AI systems.

Text Books

1. Jurafsky, D., & Martin, J. H. (2023). *Speech and Language Processing*. Pearson.
2. Manning, C. D., Raghavan, P., & Schütze, H. (2009). *Introduction to Information Retrieval*. Cambridge University Press.
3. Eisenstein, J. (2019). *Introduction to Natural Language Processing*. MIT Press.
4. Goldberg, Y. (2017). *Neural Network Methods for Natural Language Processing*. Morgan & Claypool.
5. Bird, S., Klein, E., & Loper, E. (2009). *Natural Language Processing with Python*. O'Reilly Media.

Reference Books

1. Aggarwal, C. C., & Zhai, C. (2012). *Mining Text Data*. Springer.
2. Goldberg, Y. (2016). *A Primer on Neural Network Models for NLP*. Morgan & Claypool.
3. Liu, B. (2020). *Sentiment Analysis*. Cambridge University Press.
4. Srivastava, A. (2018). *Text Mining*. CRC Press.
5. Feldman, R., & Sanger, J. (2007). *The Text Mining Handbook*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Optimization Techniques for AI

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce optimization principles for AI models
2. Develop mathematical formulation of optimization problems
3. Enable application of unconstrained and constrained techniques
4. Explain heuristic and metaheuristic approaches
5. Support performance improvement in AI systems

Course Outcomes
CO1 – Formulate optimization problems mathematically
CO2 – Apply classical optimization techniques
CO3 – Analyze constrained optimization methods
CO4 – Use heuristic optimization approaches
CO5 – Relate optimization techniques to AI model training

Detailed Syllabus

Unit I
Optimization concepts; objective functions; decision variables; constraints; optimization problem classification; convexity concepts; analytical relevance; optimization role in artificial intelligence systems.

Unit II
Unconstrained optimization; gradient based methods; steepest descent; Newton method; convergence criteria; line search strategies; analytical performance considerations; computational efficiency aspects.

Unit III
Constrained optimization; equality and inequality constraints; Lagrange multipliers; Karush Kuhn Tucker conditions; feasibility; analytical interpretation; applications in AI model training.

Unit IV
Heuristic optimization; genetic algorithms; particle swarm optimization; simulated annealing; population based search; parameter tuning; analytical relevance; exploration exploitation balance concepts.

Unit V
Optimization in machine learning; loss minimization; regularization effects; hyperparameter

tuning; optimization challenges; scalability considerations; relevance to deep learning and AI systems.

Text Books

1. Nocedal, J., & Wright, S. J. (2006). *Numerical Optimization*. Springer.
2. Boyd, S., & Vandenberghe, L. (2004). *Convex Optimization*. Cambridge University Press.
3. Chong, E. K. P., & Zak, S. H. (2013). *An Introduction to Optimization*. Wiley.
4. Sivanandam, S. N., & Deepa, S. N. (2008). *Introduction to Genetic Algorithms*. Springer.
5. Bazaraa, M. S., Sherali, H. D., & Shetty, C. M. (2013). *Nonlinear Programming*. Wiley.

Reference Books

1. Bertsekas, D. P. (2016). *Nonlinear Programming*. Athena Scientific.
2. Rao, S. S. (2019). *Engineering Optimization*. Wiley.
3. Kochenderfer, M. J., & Wheeler, T. A. (2019). *Algorithms for Optimization*. MIT Press.
4. Holland, J. H. (1992). *Adaptation in Natural and Artificial Systems*. MIT Press.
5. Talbi, E. G. (2009). *Metaheuristics*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I (IoT Analytics / Business Analytics)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide interdisciplinary exposure through elective options
2. Introduce analytics applications in emerging domains
3. Develop applied analytical thinking skills
4. Enable domain specific data interpretation
5. Support flexible learning pathways

Course Outcomes
CO1 – Explain domain specific analytics concepts
CO2 – Apply analytical methods to domain data
CO3 – Interpret analytics driven insights
CO4 – Analyze domain challenges using data
CO5 – Relate analytics techniques to professional applications

Detailed Syllabus

Unit I
Domain analytics overview; IoT analytics and business analytics context; data sources; application scenarios; analytical relevance; interdisciplinary integration foundations.

Unit II
Data acquisition; sensors and transactional systems; data preprocessing; streaming data concepts; data quality considerations; analytical relevance to domain datasets.

Unit III
Descriptive analytics; dashboards; reporting techniques; visualization tools; performance indicators; analytical interpretation; decision support relevance.

Unit IV
Predictive analytics; regression models; classification concepts; forecasting basics; domain application relevance; analytical insight generation.

Unit V
Prescriptive analytics overview; optimization concepts; decision models; ethical considerations; future trends; professional relevance; analytics driven strategy foundations.

Text Books

1. Provost, F., & Fawcett, T. (2013). *Data Science for Business*. O'Reilly Media.
2. Bahga, A., & Madisetti, V. (2014). *Internet of Things*. VPT.
3. Sharda, R., Delen, D., & Turban, E. (2018). *Business Intelligence and Analytics*. Pearson.
4. McAfee, A., & Brynjolfsson, E. (2017). *Machine, Platform, Crowd*. Norton.
5. Watson, H. J. (2014). *Business Analytics*. Pearson.

Reference Books

1. Alpaydin, E. (2020). *Introduction to Machine Learning*. MIT Press.
2. Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big Data, Big Analytics*. Wiley.
3. Davenport, T. H., & Harris, J. G. (2017). *Competing on Analytics*. Harvard Business Press.
4. Manyika, J., et al. (2011). *Big Data*. McKinsey Global Institute.

5. Chen, M., Mao, S., & Liu, Y. (2014). *Big Data*. Mobile Networks and Applications.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

AI & Data Analytics Laboratory

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Develop practical skills in AI and data analytics
2. Apply theoretical concepts using tools and frameworks
3. Enable implementation of machine learning models
4. Strengthen data handling and evaluation skills
5. Prepare students for industry oriented analytics tasks

Course Outcomes
CO1 – Implement machine learning and analytics workflows
CO2 – Apply data preprocessing and modeling techniques
CO3 – Evaluate analytical models using metrics
CO4 – Use programming tools for AI applications
CO5 – Demonstrate disciplined laboratory practices

List of Experiments / Exercises

1. Implementation of data preprocessing techniques using Python libraries, including data cleaning, normalization, handling missing values, and exploratory summaries for structured datasets.
2. Development of regression models on real datasets using machine learning libraries, including model training, prediction, and performance evaluation using appropriate error metrics.
3. Implementation of classification algorithms such as k nearest neighbors and decision trees, focusing on feature selection, model training, and classification performance analysis.
4. Clustering analysis using k means and hierarchical clustering techniques, including distance measure selection, cluster evaluation, and interpretation of grouping results.

5. Association rule mining using Apriori algorithm, including frequent itemset generation, rule extraction, and interpretation of support and confidence measures.
6. Implementation of simple neural network models using deep learning frameworks, focusing on network configuration, training process, and loss behavior analysis.
7. Development of convolutional neural network models for image datasets, including feature extraction, training, and performance evaluation.
8. Natural language processing experiments involving text preprocessing, vectorization, and basic text classification using standard NLP libraries.
9. Visualization of analytical results using plotting libraries, including charts, dashboards, and interpretive visual summaries for decision support.
10. Mini project integrating data preprocessing, model development, evaluation, and result presentation for a chosen analytics problem.

Expected Outcomes
Ability to design, implement, and evaluate AI and data analytics solutions using standard tools, demonstrating readiness for advanced applications, projects, and industry oriented problem solving.

Evaluation Scheme
Continuous Assessment (60%) + End-Semester Practical Examination (40%)

Internship

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued industry exposure and practical experience
2. Strengthen application of AI and analytics knowledge
3. Develop professional competence and discipline
4. Encourage reflective learning from workplace practices
5. Prepare students for project oriented work

Course Outcomes
CO1 – Apply academic learning in professional environments
CO2 – Observe advanced industry workflows
CO3 – Demonstrate professional ethics and conduct

CO4 – Prepare detailed internship documentation
CO5 – Integrate internship learning with academic objectives

Guidelines
Industry or research based internship under approved supervision; maintenance of daily activity log; submission of structured report; presentation and evaluation as per institutional norms.

Evaluation Scheme
Continuous Assessment and Report Evaluation (100%)

SEMESTER V

Computer Vision & Image Analytics

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Establish foundations of image formation and representation
2. Enable understanding of digital image processing techniques
3. Develop competence in feature extraction and analysis
4. Introduce vision based learning models
5. Prepare learners for advanced vision applications

Course Outcomes
CO1 – Explain image representation and acquisition models
CO2 – Apply image enhancement and transformation techniques
CO3 – Extract and analyze visual features
CO4 – Use vision based learning approaches
CO5 – Relate computer vision methods to real applications

Detailed Syllabus

Unit I
Image processing fundamentals; image formation models; sampling and quantization; grayscale and color images; spatial resolution; pixel relationships; image representation formats; analytical relevance; vision system foundations for digital image analytics.

Unit II
Image enhancement techniques; point operations; histogram processing; contrast stretching; spatial filtering; smoothing and sharpening filters; noise models; analytical interpretation; preprocessing relevance for vision based analysis pipelines.

Unit III
Image transformations; geometric transformations; interpolation methods; frequency domain concepts; Fourier transform basics; filtering in frequency domain; analytical relevance; feature preservation considerations in transformed image spaces.

Unit IV
Feature detection and description; edge detection methods; corner detection; texture analysis;

shape descriptors; feature matching concepts; analytical interpretation; relevance to object recognition and image understanding tasks.

Unit V
Image classification and recognition; traditional vision pipelines; feature based classification; introduction to deep learning for vision; convolutional network overview; application domains; analytical relevance to modern computer vision systems.

Text Books

1. Gonzalez, R. C., & Woods, R. E. (2018). *Digital Image Processing* (4th ed.). Pearson.
2. Szeliski, R. (2022). *Computer Vision: Algorithms and Applications* (2nd ed.). Springer.
3. Prince, S. J. D. (2012). *Computer Vision: Models, Learning, and Inference*. Cambridge University Press.
4. Forsyth, D. A., & Ponce, J. (2011). *Computer Vision: A Modern Approach*. Pearson.
5. Burger, W., & Burge, M. J. (2016). *Digital Image Processing*. Springer.

Reference Books

1. Sonka, M., Hlavac, V., & Boyle, R. (2014). *Image Processing, Analysis, and Machine Vision*. Cengage.
2. Nixon, M., & Aguado, A. (2019). *Feature Extraction and Image Processing for Computer Vision*. Academic Press.
3. Jain, A. K. (2018). *Fundamentals of Digital Image Processing*. Pearson.
4. Milanfar, P. (2013). *A Tour of Modern Image Processing*. IEEE Press.
5. Bovik, A. (2010). *The Essential Guide to Image Processing*. Academic Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Time Series Analysis & Forecasting

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce time dependent data characteristics
2. Develop understanding of time series components

3. Enable modeling of temporal patterns
4. Apply forecasting techniques for analytics
5. Support decision making using temporal data

Course Outcomes
CO1 – Identify components of time series data
CO2 – Apply decomposition and smoothing techniques
CO3 – Build time series models
CO4 – Perform forecasting and evaluation
CO5 – Relate temporal models to analytics applications

Detailed Syllabus

Unit I
Time series concepts; temporal data characteristics; components of time series; trend, seasonality, cyclic variations; visualization techniques; analytical relevance; applications in economics, engineering, and data analytics contexts.

Unit II
Stationarity concepts; random walk models; autocorrelation; partial autocorrelation; correlogram analysis; analytical interpretation; transformation techniques; differencing methods; relevance to time series modeling foundations.

Unit III
Smoothing techniques; moving averages; exponential smoothing; single, double, triple smoothing; parameter selection; analytical interpretation; short term forecasting relevance; noise reduction considerations in temporal data.

Unit IV
ARIMA models; autoregressive models; moving average models; ARMA formulation; model identification; parameter estimation; diagnostic checking; analytical relevance; forecasting accuracy considerations.

Unit V
Forecast evaluation; error measures; mean absolute error; mean squared error; model comparison; seasonal forecasting overview; applications; analytical relevance; integration with machine learning based forecasting approaches.

Text Books

1. Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2016). *Time Series Analysis: Forecasting and Control*. Wiley.
2. Brockwell, P. J., & Davis, R. A. (2016). *Introduction to Time Series and Forecasting*. Springer.
3. Shumway, R. H., & Stoffer, D. S. (2017). *Time Series Analysis and Its Applications*. Springer.

4. Montgomery, D. C., Jennings, C. L., & Kulahci, M. (2015). *Introduction to Time Series Analysis and Forecasting*. Wiley.
5. Chatfield, C. (2016). *The Analysis of Time Series*. CRC Press.

Reference Books

1. Hamilton, J. D. (2020). *Time Series Analysis*. Princeton University Press.
2. Hyndman, R. J., & Athanasopoulos, G. (2018). *Forecasting: Principles and Practice*. OTexts.
3. Wei, W. W. S. (2019). *Time Series Analysis*. Pearson.
4. Cryer, J. D., & Chan, K. S. (2008). *Time Series Analysis with Applications in R*. Springer.
5. Enders, W. (2015). *Applied Econometric Time Series*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Cloud Computing for Data Analytics

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce cloud computing principles and models
2. Develop understanding of cloud service architectures
3. Enable deployment of analytics applications on cloud
4. Explain scalability and resource management
5. Support modern data analytics infrastructures

Course Outcomes
CO1 – Explain cloud computing concepts and models
CO2 – Apply cloud services for data storage and processing
CO3 – Analyze cloud based analytics architectures
CO4 – Understand virtualization and containerization concepts
CO5 – Relate cloud platforms to analytics workloads

Detailed Syllabus

Unit I
Cloud computing overview; evolution of computing paradigms; service models; deployment models; cloud architecture; characteristics; analytical relevance; role of cloud platforms in data analytics ecosystems.

Unit II
Virtualization concepts; hypervisors; virtual machines; resource pooling; scalability; elasticity; analytical relevance; infrastructure management considerations for analytics workloads.

Unit III
Cloud storage systems; object storage; block storage; distributed databases; data consistency; availability considerations; analytical relevance; handling large scale analytics data.

Unit IV
Cloud based data processing; analytics services overview; batch and stream processing; workflow orchestration; performance considerations; analytical relevance to scalable analytics pipelines.

Unit V
Security and governance; cloud security threats; access control; data privacy; compliance issues; cost management; analytical relevance; best practices for cloud based analytics solutions.

Text Books

1. Buyya, R., Vecchiola, C., & Selvi, S. T. (2013). *Mastering Cloud Computing*. Morgan Kaufmann.
2. Erl, T., Puttini, R., & Mahmood, Z. (2013). *Cloud Computing: Concepts, Technology & Architecture*. Prentice Hall.
3. Armbrust, M., et al. (2010). *A View of Cloud Computing*. Communications of the ACM.
4. Rittinghouse, J. W., & Ransome, J. F. (2017). *Cloud Computing*. CRC Press.
5. Marinescu, D. C. (2018). *Cloud Computing: Theory and Practice*. Morgan Kaufmann.

Reference Books

1. Fox, A., & Patterson, D. (2012). *Engineering Long-Lasting Software*. Strawberry Canyon.
2. Kleppmann, M. (2017). *Designing Data-Intensive Applications*. O'Reilly Media.
3. Velte, A. T., Velte, T. J., & Elsenpeter, R. (2010). *Cloud Computing*. McGraw-Hill.
4. Jamsa, K. (2013). *Cloud Computing*. Jones & Bartlett.
5. Furht, B., & Escalante, A. (2010). *Handbook of Cloud Computing*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Responsible AI & Data Governance

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce ethical and responsible AI principles
2. Develop understanding of data governance frameworks
3. Enable assessment of fairness and accountability
4. Explain regulatory and compliance requirements
5. Promote socially responsible AI development

Course Outcomes
CO1 – Explain principles of responsible and ethical AI
CO2 – Identify risks and biases in AI systems
CO3 – Apply data governance practices
CO4 – Understand legal and regulatory considerations
CO5 – Promote trustworthy AI deployment

Detailed Syllabus

Unit I
Responsible AI concepts; ethical foundations; transparency; accountability; explainability; trust in AI systems; analytical relevance; societal impact considerations in artificial intelligence applications.

Unit II
Bias and fairness; sources of bias; data bias; algorithmic bias; fairness metrics; mitigation strategies; analytical interpretation; relevance to equitable AI system design.

Unit III
Data governance fundamentals; data quality; data stewardship; data lifecycle management; metadata management; analytical relevance; organizational governance frameworks for data driven systems.

Unit IV
Privacy and security; data protection principles; anonymization; consent management;

cybersecurity overview; analytical relevance; protection of sensitive data in analytics and AI applications.

Unit V
Regulations and compliance; AI governance standards; legal frameworks; auditability; risk management; future trends; analytical relevance; responsible innovation and deployment practices.

Text Books

1. Floridi, L. (2019). *The Ethics of Artificial Intelligence*. Oxford University Press.
2. Mittelstadt, B. (2022). *Ethics of Artificial Intelligence*. Oxford University Press.
3. Richards, N. M., & King, J. H. (2014). *Big Data Ethics*. Stanford Law Review.
4. Kitchin, R. (2014). *The Data Revolution*. SAGE.
5. O'Neil, C. (2016). *Weapons of Math Destruction*. Crown.

Reference Books

1. Barocas, S., Hardt, M., & Narayanan, A. (2019). *Fairness and Machine Learning*. fairmlbook.org.
2. Tufekci, Z. (2017). *Twitter and Tear Gas*. Yale University Press.
3. Solove, D. J. (2021). *Understanding Privacy*. Harvard University Press.
4. Crawford, K. (2021). *Atlas of AI*. Yale University Press.
5. European Commission. (2021). *Ethics Guidelines for Trustworthy AI*. EU Publications.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I (Healthcare Analytics / Financial Analytics)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide domain focused analytics specialization
2. Introduce healthcare and financial data characteristics
3. Enable application of analytics in professional domains

4. Develop sector specific analytical reasoning
5. Support career oriented skill development

Course Outcomes
CO1 – Explain domain specific analytics foundations
CO2 – Apply analytics techniques to domain datasets
CO3 – Interpret insights for professional decisions
CO4 – Analyze domain challenges using data
CO5 – Relate analytics outcomes to industry practices

Detailed Syllabus

Unit I
Domain analytics overview; healthcare analytics and financial analytics context; data sources; domain challenges; analytical relevance; interdisciplinary integration foundations for applied analytics.

Unit II
Data preprocessing; domain specific data quality issues; feature selection; normalization; analytical relevance; preparation of healthcare and financial datasets for analytics workflows.

Unit III
Descriptive analytics; key performance indicators; dashboards; reporting techniques; analytical interpretation; domain decision support relevance.

Unit IV
Predictive analytics; risk modeling; classification and regression models; forecasting concepts; analytical relevance; professional application scenarios.

Unit V
Regulatory and ethical considerations; data privacy; compliance standards; domain governance; future trends; analytical relevance; responsible analytics practices in professional domains.

Text Books

1. Raghupathi, W., & Raghupathi, V. (2014). *Healthcare Analytics*. CRC Press.
2. Provost, F., & Fawcett, T. (2013). *Data Science for Business*. O'Reilly Media.
3. Dixon, M. F., Halperin, I., & Bilokon, P. (2020). *Machine Learning in Finance*. Springer.
4. Sharda, R., Delen, D., & Turban, E. (2018). *Business Intelligence and Analytics*. Pearson.
5. Wager, K. A., Lee, F. W., & Glaser, J. P. (2017). *Health Care Information Systems*. Wiley.

Reference Books

1. Obermeyer, Z., & Emanuel, E. J. (2016). *Predicting the Future — Big Data, Machine Learning, and Clinical Medicine*. NEJM.
2. Tsay, R. S. (2010). *Analysis of Financial Time Series*. Wiley.
3. Davenport, T. H., & Harris, J. G. (2017). *Competing on Analytics*. Harvard Business Press.
4. Murphy, K. P. (2022). *Machine Learning: A Probabilistic Perspective*. MIT Press.
5. Aggarwal, C. C. (2018). *Data Mining*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project (AI / Data Analytics Application)

Course Category
Project Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Apply AI and analytics concepts to practical problems
2. Develop problem formulation and solution skills
3. Encourage independent and team based learning
4. Strengthen documentation and presentation abilities
5. Prepare for major project and industry engagement

Course Outcomes
CO1 – Identify and define real world analytics problems
CO2 – Design and implement AI based solutions
CO3 – Apply appropriate tools and methodologies
CO4 – Analyze results and validate outcomes
CO5 – Present and document project work effectively

Guidelines
Problem identification; literature review; solution design; implementation using appropriate tools; result analysis; documentation; periodic reviews; final presentation and evaluation as per institutional norms.

Evaluation Scheme
Continuous Assessment (50%) + Project Evaluation and Viva-Voce (50%)

SEMESTER VI

Advanced Machine Learning Techniques

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Extend knowledge of advanced machine learning algorithms
2. Develop understanding of ensemble and probabilistic models
3. Enable handling of complex, high dimensional datasets
4. Introduce advanced learning paradigms
5. Prepare learners for research and industry applications

Course Outcomes
CO1 – Apply ensemble learning techniques effectively
CO2 – Analyze probabilistic and kernel based models
CO3 – Handle high dimensional data challenges
CO4 – Evaluate advanced learning models
CO5 – Relate advanced techniques to real world applications

Detailed Syllabus

Unit I
Advanced learning concepts; bias variance revisited; ensemble learning overview; bagging techniques; random forests; boosting concepts; model aggregation strategies; analytical relevance; performance improvement foundations for predictive systems.

Unit II
Support vector machines; margin maximization; kernel functions; linear and non linear classification; hyperparameter tuning; analytical interpretation; robustness considerations; relevance to complex pattern recognition problems.

Unit III
Probabilistic learning models; Bayesian learning concepts; naive Bayes extensions; Bayesian networks; inference mechanisms; uncertainty handling; analytical relevance; probabilistic reasoning foundations in machine learning systems.

Unit IV
Dimensionality reduction techniques; principal component analysis; linear discriminant

analysis; manifold learning overview; feature extraction relevance; analytical interpretation; handling high dimensional data challenges.

Unit V
Advanced learning paradigms; semi supervised learning; online learning; transfer learning concepts; scalability issues; application relevance; integration with deep learning and real world deployment considerations.

Text Books

1. Murphy, K. P. (2022). *Machine Learning: A Probabilistic Perspective*. MIT Press.
2. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
3. Hastie, T., Tibshirani, R., & Friedman, J. (2017). *The Elements of Statistical Learning*. Springer.
4. Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2018). *Foundations of Machine Learning*. MIT Press.
5. Alpaydin, E. (2020). *Introduction to Machine Learning* (4th ed.). MIT Press.

Reference Books

1. Shalev-Shwartz, S., & Ben-David, S. (2014). *Understanding Machine Learning*. Cambridge University Press.
2. Kelleher, J. D., Mac Namee, B., & D'Arcy, A. (2020). *Fundamentals of Machine Learning for Predictive Data Analytics*. MIT Press.
3. Géron, A. (2022). *Hands-On Machine Learning*. O'Reilly Media.
4. Domingos, P. (2015). *The Master Algorithm*. Basic Books.
5. Vapnik, V. N. (2013). *The Nature of Statistical Learning Theory*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

AI in Industry & Smart Systems

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce industrial AI applications and smart systems
2. Develop understanding of AI driven automation

3. Enable analysis of cyber physical and smart environments
4. Explain integration of AI with IoT and industry systems
5. Prepare learners for industry oriented AI deployment

Course Outcomes
CO1 – Explain AI applications in industrial contexts
CO2 – Analyze smart system architectures
CO3 – Apply AI techniques to industrial data
CO4 – Understand deployment challenges in industry
CO5 – Relate AI systems to real world industrial use cases

Detailed Syllabus

Unit I
Industrial AI overview; smart manufacturing concepts; industry 4.0 foundations; cyber physical systems; automation relevance; analytical integration of AI in industrial environments.

Unit II
Smart sensing systems; IoT integration; data acquisition; edge analytics concepts; real time processing; analytical relevance; intelligent monitoring foundations.

Unit III
Predictive maintenance; anomaly detection; fault diagnosis; reliability analysis; analytical relevance; application of machine learning models in industrial operations.

Unit IV
Smart decision systems; optimization in industry; supply chain analytics; production planning; analytical relevance; AI driven decision support systems.

Unit V
Deployment and challenges; scalability; interoperability; security concerns; ethical considerations; future trends; analytical relevance; adoption of AI in industrial ecosystems.

Text Books

1. Lee, J., Bagheri, B., & Kao, H. A. (2015). *A Cyber-Physical Systems Architecture for Industry 4.0*. Manufacturing Letters.
2. Kagermann, H., Wahlster, W., & Helbig, J. (2013). *Recommendations for Implementing Industry 4.0*. Acatech.
3. Min, H. (2015). *The Essentials of Supply Chain Management*. Pearson.
4. Raghavan, V. V., & Venkatesh, R. (2019). *Artificial Intelligence Applications in Manufacturing*. Springer.
5. Groover, M. P. (2016). *Automation, Production Systems, and Computer-Integrated Manufacturing*. Pearson.

Reference Books

1. Monostori, L. (2014). *Cyber-Physical Systems*. CIRP Annals.
2. Xu, L. D., Xu, E. L., & Li, L. (2018). *Industry 4.0*. IEEE Transactions.
3. Porter, M. E., & Heppelmann, J. E. (2015). *How Smart, Connected Products Are Transforming Companies*. Harvard Business Review.
4. Manyika, J., et al. (2017). *Artificial Intelligence: The Next Digital Frontier*. McKinsey.
5. Brynjolfsson, E., & McAfee, A. (2017). *Machine, Platform, Crowd*. Norton.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Emerging Trends in Artificial Intelligence

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Introduce recent advancements in artificial intelligence
2. Develop awareness of cutting edge AI research areas
3. Enable analysis of emerging AI technologies
4. Encourage continuous learning mindset
5. Prepare learners for future AI developments

Course Outcomes
CO1 – Identify emerging AI trends and technologies
CO2 – Analyze impact of new AI paradigms
CO3 – Interpret research directions in AI
CO4 – Evaluate opportunities and challenges
CO5 – Relate emerging trends to professional growth

Detailed Syllabus

Unit I
Emerging AI landscape; evolution of AI technologies; research driven innovations; interdisciplinary convergence; analytical relevance; future directions in artificial intelligence systems.

Unit II
Explainable AI concepts; model interpretability; transparency requirements; trust in AI systems; analytical relevance; application scenarios and regulatory perspectives.

Unit III
Federated learning concepts; privacy preserving learning; distributed model training; communication efficiency; analytical relevance; decentralized AI system foundations.

Unit IV
Generative AI overview; generative models; variational autoencoders; generative adversarial networks; applications; analytical relevance; creative and synthetic data generation foundations.

Unit V
Artificial general intelligence overview; AI safety concerns; ethical implications; societal impact; future outlook; analytical relevance; long term perspectives of AI development.

Text Books

1. Russell, S. J., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
3. Floridi, L. (2019). *The Ethics of Artificial Intelligence*. Oxford University Press.
4. Boden, M. A. (2016). *AI: Its Nature and Future*. Oxford University Press.
5. Prince, S. J. D. (2023). *Understanding Deep Learning*. MIT Press.

Reference Books

1. Schmidhuber, J. (2015). *Deep Learning in Neural Networks*. Neural Networks.
2. Kaplan, J. (2016). *Artificial Intelligence: What Everyone Needs to Know*. Oxford University Press.
3. Crawford, K. (2021). *Atlas of AI*. Yale University Press.
4. Barocas, S., Hardt, M., & Narayanan, A. (2019). *Fairness and Machine Learning*. Cambridge University Press.
5. Tegmark, M. (2017). *Life 3.0*. Knopf.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II (Cybersecurity Analytics / Marketing Analytics)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Provide interdisciplinary elective exposure
2. Introduce analytics in cybersecurity and marketing domains
3. Develop applied analytical reasoning skills
4. Enable domain specific data interpretation
5. Support flexible professional pathways

Course Outcomes
CO1 – Explain domain specific analytics concepts
CO2 – Apply analytics techniques to domain datasets
CO3 – Interpret analytical insights
CO4 – Analyze domain problems using data
CO5 – Relate analytics outcomes to professional practices

Detailed Syllabus

Unit I
Domain analytics overview; cybersecurity analytics and marketing analytics context; data sources; challenges; analytical relevance; interdisciplinary application foundations.

Unit II
Data collection; logs, transactions; customer behavior data; preprocessing; feature engineering; analytical relevance to domain datasets.

Unit III
Descriptive and diagnostic analytics; dashboards; metrics; visualization; analytical interpretation; decision support relevance.

Unit IV
Predictive analytics; anomaly detection; classification models; churn analysis; threat detection concepts; analytical relevance to domain problems.

Unit V
Prescriptive analytics; optimization concepts; response strategies; ethical considerations; future trends; analytical relevance; professional application foundations.

Text Books

1. Provost, F., & Fawcett, T. (2013). *Data Science for Business*. O'Reilly Media.

2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
3. Laudon, K. C., & Laudon, J. P. (2017). *Management Information Systems*. Pearson.
4. Bose, I., & Mahapatra, R. K. (2001). *Business Data Mining*. MIS Quarterly.
5. Anderson, R. (2020). *Security Engineering*. Wiley.

Reference Books

1. Sharda, R., Delen, D., & Turban, E. (2018). *Business Intelligence and Analytics*. Pearson.
2. Tsay, R. S. (2010). *Analysis of Financial Time Series*. Wiley.
3. Dal Pozzolo, A., et al. (2018). *Adversarial Drift Detection*. IEEE.
4. Davenport, T. H., & Harris, J. G. (2017). *Competing on Analytics*. Harvard Business Press.
5. Sommer, R., & Paxson, V. (2010). *Outside the Closed World*. IEEE.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project (Industry / Research Based)

Course Category
Project Course

Credits / Contact Hours
6 Credits / 90 Contact Hours

Course Objectives

1. Solve complex real world problems using AI and analytics
2. Integrate theoretical knowledge with practical implementation
3. Develop research and innovation capabilities
4. Strengthen technical documentation and presentation skills
5. Prepare for professional and academic careers

Course Outcomes
CO1 – Define and formulate complex analytics problems
CO2 – Design and implement advanced AI solutions
CO3 – Apply appropriate tools and methodologies
CO4 – Analyze results and validate outcomes
CO5 – Present research or industry project professionally

Guidelines
Problem formulation; literature survey; methodology design; implementation; experimentation; result analysis; dissertation preparation; evaluation through reviews, report, and viva voce as per institutional norms.

Evaluation Scheme
Continuous Assessment (40%) + Project Evaluation and Viva-Voce (60%)

Seminar / Viva-Voce

Course Category
Seminar

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical presentation and communication skills
2. Encourage independent study on advanced topics
3. Enhance critical analysis and articulation abilities
4. Prepare students for professional interactions
5. Support lifelong learning orientation

Course Outcomes
CO1 – Present technical topics effectively
CO2 – Demonstrate understanding of chosen domain
CO3 – Analyze and respond to technical queries
CO4 – Exhibit professional communication skills
CO5 – Reflect independent learning capability

Guidelines
Topic selection from AI and data analytics domains; literature survey; seminar presentation; report submission; viva voce examination; evaluation based on content, presentation, and understanding.

Evaluation Scheme
Seminar Presentation (50%) + Viva-Voce Examination (50%)

B.Sc. – Cyber Systems & Forensic Sciences

Duration: 3 Years | 6 Semesters | Total Credits: 120

SEMESTER I

Mathematics I (Discrete Mathematics & Linear Algebra)
Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical foundations for discrete structures and linear systems
2. Enable logical reasoning and abstraction for computing applications
3. Apply matrix methods to engineering and cyber system problems
4. Strengthen problem solving using algebraic and combinatorial techniques
5. Prepare analytical base for advanced computing and security courses

Course Outcomes
CO1 Apply set theory and logic to model computational problems
CO2 Analyze relations and functions relevant to cyber systems
CO3 Solve problems using matrix algebra and vector spaces
CO4 Apply eigenvalues and linear transformations in system analysis
CO5 Integrate discrete and linear methods for engineering applications

Detailed Syllabus

Unit I
Sets, relations, functions; propositional logic, predicate logic; logical equivalence, inference rules; truth tables, normal forms; counting principles, permutations, combinations; discrete structures, abstraction techniques; applications in computing systems, algorithmic reasoning, cyber problem modeling.

Unit II
Recurrence relations, solution techniques; generating functions, applications; graphs, digraphs, trees; graph representations, connectivity, traversal concepts; applications in network modeling, cyber topology analysis; discrete optimization problems, path analysis, system interconnections.

Unit III
Matrices, matrix operations; systems of linear equations, Gaussian elimination; vector spaces, subspaces, linear independence, basis, dimension; applications in data representation, state modeling, cyber system computations, computational efficiency analysis.

Unit IV
Linear transformations, matrix representation; rank, nullity; determinants, properties, computation methods; applications in system solvability, encryption modeling, transformation analysis, computational stability, cyber signal representation, algorithm performance evaluation.

Unit V
Eigenvalues, eigenvectors; characteristic equations; diagonalization; applications in system dynamics, stability analysis; Markov models; linear algebra applications in network analysis, cryptographic algorithms, cyber risk modeling, engineering problem solving.

Text Books

1. Rosen, K. H. (2019). *Discrete mathematics and its applications* (8th ed.). McGraw-Hill Education.
2. Strang, G. (2016). *Introduction to linear algebra* (5th ed.). Wellesley-Cambridge Press.
3. Lay, D. C., Lay, S. R., & McDonald, J. J. (2016). *Linear algebra and its applications* (5th ed.). Pearson Education.
4. Epp, S. S. (2019). *Discrete mathematics with applications* (5th ed.). Cengage Learning.
5. Anton, H., Rorres, C., & Kaul, A. (2018). *Elementary linear algebra* (12th ed.). Wiley.

Reference Books

1. Kolman, B., Busby, R., & Ross, S. (2018). *Discrete mathematical structures* (6th ed.). Pearson.
2. Gross, J. L., & Yellen, J. (2018). *Graph theory and its applications* (3rd ed.). CRC Press.
3. Meyer, C. D. (2000). *Matrix analysis and applied linear algebra*. SIAM.
4. Lipschutz, S., & Lipson, M. (2017). *Linear algebra* (4th ed.). McGraw-Hill.
5. Tucker, A. (2017). *Applied combinatorics* (6th ed.). Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Fundamentals of Computer Systems
Course Category: Engineering Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand foundational concepts of computer system architecture
2. Analyze hardware–software interaction mechanisms
3. Develop knowledge of system components and data representation
4. Build conceptual base for operating systems and networking
5. Enable analytical understanding of computing performance

Course Outcomes
CO1 Explain computer system components and organization
CO2 Analyze data representation and arithmetic operations
CO3 Understand processor architecture and instruction execution
CO4 Identify memory hierarchy and storage mechanisms
CO5 Relate system fundamentals to cyber infrastructure

Detailed Syllabus

Unit I
Computer system overview; hardware, software, firmware; data representation, number systems; binary arithmetic; signed, unsigned representation; character encoding; computing abstractions; system performance parameters; cyber system relevance.

Unit II
Processor organization; instruction cycle, addressing modes; instruction set architecture; registers, control unit; arithmetic logic unit; pipelining concepts; performance metrics; processor efficiency; system throughput analysis.

Unit III
Memory hierarchy; primary memory, cache organization; secondary storage devices; access methods; virtual memory concepts; memory management fundamentals; performance tradeoffs; data integrity considerations in cyber environments.

Unit IV
Input–output organization; I O devices, interfaces; interrupt mechanisms; direct memory access; system buses; communication pathways; peripheral management; reliability and fault tolerance considerations.

Unit V
System software overview; assemblers, compilers, loaders; booting process; system security basics; trusted computing base; hardware vulnerabilities; system level attack surfaces; foundational cyber system protection concepts.

Text Books

1. Stallings, W. (2019). *Computer organization and architecture* (11th ed.). Pearson Education.
2. Mano, M. M., & Ciletti, M. D. (2017). *Digital design* (6th ed.). Pearson.
3. Patterson, D. A., & Hennessy, J. L. (2021). *Computer organization and design* (6th ed.). Morgan Kaufmann.
4. Tanenbaum, A. S., & Austin, T. (2018). *Structured computer organization* (6th ed.). Pearson.
5. Null, L., & Lobur, J. (2018). *The essentials of computer organization and architecture* (5th ed.). Jones & Bartlett.

Reference Books

1. Hamacher, V. C., Vranesic, Z. G., & Zaky, S. G. (2019). *Computer organization* (6th ed.). McGraw-Hill.
2. Harris, D. M., & Harris, S. L. (2021). *Digital design and computer architecture* (3rd ed.). Morgan Kaufmann.
3. Bryant, R. E., & O'Hallaron, D. R. (2016). *Computer systems: A programmer's perspective* (3rd ed.). Pearson.
4. Stallings, W. (2018). *Operating systems: Internals and design principles* (9th ed.). Pearson.
5. Shen, J. P., & Lipasti, M. (2013). *Modern processor design*. McGraw-Hill.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Programming Fundamentals (C / Python)
Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop structured programming skills using C and Python
2. Understand algorithmic thinking and problem decomposition
3. Apply programming constructs for computational tasks
4. Build foundation for advanced programming and security tools
5. Enhance logical reasoning through code development

Course Outcomes
CO1 Write structured programs using fundamental constructs
CO2 Apply control structures and data types effectively
CO3 Develop modular programs using functions
CO4 Analyze program correctness and efficiency
CO5 Use programming for cyber and forensic applications

Detailed Syllabus

Unit I
Programming concepts; problem solving techniques; algorithms, flowcharts; program structure; compilation, execution process; syntax fundamentals; programming environments; debugging basics; secure coding awareness.

Unit II
Data types, variables, constants; operators, expressions; input output functions; control structures, conditional statements; looping constructs; iteration logic; computational efficiency considerations.

Unit III
Functions, parameter passing; recursion concepts; scope, lifetime of variables; program modularity; code reuse; error handling fundamentals; testing strategies; maintainability aspects.

Unit IV
Arrays, strings; memory representation; pointers concepts; dynamic memory allocation; basic data structures; application oriented programming tasks; performance implications; memory safety considerations.

Unit V
Introduction to Python programming; syntax, data types; control flow; functions, modules; basic file handling; scripting applications; automation concepts; relevance to cyber systems and forensic tools.

Text Books

1. Kernighan, B. W., & Ritchie, D. M. (2018). *The C programming language* (2nd ed.). Pearson.
2. Reema Thareja. (2019). *Programming in C* (2nd ed.). Oxford University Press.
3. Downey, A. B. (2016). *Think Python* (2nd ed.). O'Reilly Media.
4. Lippman, S. B. (2013). *C primer plus* (6th ed.). Addison-Wesley.
5. Guttag, J. V. (2021). *Introduction to computation and programming using Python* (3rd ed.). MIT Press.

Reference Books

1. Deitel, P., & Deitel, H. (2020). *C how to program* (9th ed.). Pearson.
2. Zelle, J. (2017). *Python programming: An introduction to computer science* (3rd ed.). Franklin, Beedle.
3. McGrath, M. (2019). *Python in easy steps* (2nd ed.). In Easy Steps.
4. Kochan, S. (2015). *Programming in C* (4th ed.). Addison-Wesley.
5. van Rossum, G., & Drake, F. L. (2011). *The Python language reference manual*. Python Software Foundation.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Basics of Cyber Systems & Networking
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamentals of cyber systems and networks
2. Understand data communication principles
3. Analyze network architectures and protocols
4. Develop foundation for cyber security studies
5. Relate networking concepts to real world cyber systems

Course Outcomes
CO1 Explain cyber system components and interactions
CO2 Describe data communication models and standards
CO3 Analyze network topologies and protocols
CO4 Identify network vulnerabilities and threats
CO5 Apply networking knowledge in cyber contexts

Detailed Syllabus

Unit I
Cyber systems overview; components, interactions; cyber physical systems; data communication basics; signals, bandwidth; transmission media; network performance parameters; reliability considerations.

Unit II
Network models; OSI, TCP IP architecture; layering principles; protocol functions; encapsulation; addressing schemes; interoperability concepts; cyber system integration.

Unit III
Local area networks; Ethernet standards; switching concepts; wireless networks; Wi Fi fundamentals; medium access techniques; network performance metrics; deployment considerations.

Unit IV
Wide area networks; routing principles; IP addressing; subnetting basics; routing protocols overview; internet architecture; service provider networks; scalability issues.

Unit V
Network security fundamentals; threats, attacks; firewalls, intrusion detection basics; secure communication principles; cyber resilience concepts; network monitoring overview.

Text Books

1. Forouzan, B. A. (2017). *Data communications and networking* (5th ed.). McGraw-Hill.
2. Kurose, J. F., & Ross, K. W. (2021). *Computer networking: A top-down approach* (8th ed.). Pearson.
3. Tanenbaum, A. S., & Wetherall, D. J. (2021). *Computer networks* (6th ed.). Pearson.
4. Stallings, W. (2017). *Data and computer communications* (10th ed.). Pearson.
5. Peterson, L. L., & Davie, B. S. (2020). *Computer networks: A systems approach* (6th ed.). Morgan Kaufmann.

Reference Books

1. Comer, D. E. (2018). *Internetworking with TCP/IP* (7th ed.). Pearson.
2. Keshav, S. (2012). *An engineering approach to computer networking*. Addison-Wesley.
3. Tannenbaum, A. (2015). *Structured computer organization*. Pearson.
4. Lewis, T. G. (2018). *Network science: Theory and applications*. Wiley.
5. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Logic & Computer Organization
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand digital logic principles and circuits

2. Analyze combinational and sequential logic systems
3. Develop understanding of computer organization basics
4. Relate logic design to system level implementation
5. Build foundation for hardware security concepts

Course Outcomes
CO1 Apply Boolean algebra and logic simplification
CO2 Design combinational logic circuits
CO3 Analyze sequential circuits and timing
CO4 Understand basic computer organization units
CO5 Relate logic design to cyber hardware systems

Detailed Syllabus

Unit I
Number systems; binary, octal, hexadecimal; Boolean algebra; logic gates; canonical forms; simplification techniques; logic implementation concepts; digital system representation.

Unit II
Combinational logic circuits; adders, subtractors; multiplexers, demultiplexers; encoders, decoders; design methodologies; functional verification; application oriented circuit design.

Unit III
Sequential logic; latches, flip flops; registers, counters; timing diagrams; clocking concepts; state machines; reliability considerations; synchronization issues.

Unit IV
Memory elements; ROM, RAM; memory organization; addressing; basic cache concepts; storage hierarchy relation; performance considerations.

Unit V
Computer organization overview; data path, control unit; instruction execution; interfacing concepts; hardware security basics; trusted hardware principles.

Text Books

1. Mano, M. M., & Ciletti, M. D. (2017). *Digital design* (6th ed.). Pearson.
2. Morris Mano. (2018). *Computer system architecture* (3rd ed.). Pearson.
3. Floyd, T. L. (2015). *Digital fundamentals* (11th ed.). Pearson.
4. Harris, D. M., & Harris, S. L. (2021). *Digital design and computer architecture* (3rd ed.). Morgan Kaufmann.
5. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2016). *Digital systems* (12th ed.). Pearson.

Reference Books

1. Roth, C. H., & Kinney, L. L. (2014). *Fundamentals of logic design* (7th ed.). Cengage.
2. Wakerly, J. F. (2017). *Digital design: Principles and practices* (5th ed.). Pearson.
3. Brown, S., & Vranesic, Z. (2013). *Fundamentals of digital logic with VHDL design*. McGraw-Hill.
4. Hayes, J. P. (2011). *Computer architecture and organization*. McGraw-Hill.
5. Stallings, W. (2019). *Computer organization and architecture*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Communication Skills & Professional English
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop professional communication competence
2. Improve technical reading and writing skills
3. Enhance presentation and interpersonal abilities
4. Strengthen workplace communication ethics
5. Prepare for professional and academic environments

Course Outcomes
CO1 Demonstrate effective oral communication skills
CO2 Apply structured professional writing techniques
CO3 Interpret technical and professional documents
CO4 Exhibit interpersonal and team communication skills
CO5 Practice ethical and professional communication

Detailed Syllabus

Unit I
Communication process; verbal, non verbal communication; listening skills; barriers; professional contexts; workplace interactions; academic communication fundamentals.

Unit II
Technical reading; comprehension strategies; vocabulary development; summarization techniques; information organization; analytical reading skills.

Unit III
Professional writing; letters, emails; reports, proposals; clarity, coherence; formatting conventions; documentation standards.

Unit IV
Oral presentations; public speaking fundamentals; group discussions; interview skills; body language; confidence building techniques.

Unit V
Professional ethics; cross cultural communication; teamwork; conflict resolution; leadership communication; workplace etiquette.

Text Books

1. Raman, M., & Sharma, S. (2018). *Technical communication* (2nd ed.). Oxford University Press.
2. Meenakshi Raman. (2019). *Professional communication*. Oxford University Press.
3. Murphy, H. A., Hildebrandt, H. W., & Thomas, J. P. (2014). *Effective business communications* (7th ed.). McGraw-Hill.
4. Bovee, C. L., & Thill, J. V. (2017). *Business communication today* (14th ed.). Pearson.
5. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2015). *Business communication: Making connections in a digital world* (12th ed.). McGraw-Hill.

Reference Books

1. Guffey, M. E., & Loewy, D. (2018). *Essentials of business communication* (11th ed.). Cengage.
2. Comfort, J., & Franklin, P. (2014). *The mindful communicator*. Kogan Page.
3. McCarthy, M., & O'Dell, F. (2017). *English vocabulary in use*. Cambridge University Press.
4. Lucas, S. E. (2015). *The art of public speaking* (12th ed.). McGraw-Hill.
5. Chaney, L. H., & Martin, J. S. (2013). *Intercultural business communication*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Computing Laboratory I
Course Category: Engineering Science Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Develop hands on programming skills

2. Apply computational thinking to problem solving
3. Use programming tools and environments effectively
4. Strengthen debugging and testing abilities
5. Reinforce theory through practical implementation

Course Outcomes
CO1 Implement basic programs using C and Python
CO2 Apply control structures and data handling
CO3 Develop modular and readable code
CO4 Debug and test programs systematically
CO5 Use programming skills in cyber applications

List of Experiments / Exercises

1. Development of simple C programs for arithmetic operations using standard input output functions, compiler usage, debugging techniques, and verification of program correctness.
2. Implementation of conditional and looping constructs in C, including if else statements, for loops, while loops, and logical decision making through practical examples.
3. Design of modular C programs using user defined functions, parameter passing methods, and evaluation of code readability and reusability.
4. Practice of array and string operations in C, including searching, sorting, memory representation, and performance evaluation of basic algorithms.
5. Introduction to pointers and dynamic memory allocation in C, including malloc, free usage, memory safety practices, and debugging memory errors.
6. Development of basic Python programs focusing on syntax, data types, and input output handling using interactive development environments.
7. Implementation of control flow and functions in Python, including conditional statements, loops, modular programming, and code testing.
8. Practice of list, tuple, dictionary operations in Python, focusing on data manipulation, iteration, and application oriented tasks.
9. File handling in Python, including reading, writing, and processing text files with attention to data integrity and error handling.
10. Mini programming exercise integrating C or Python to solve a problem related to cyber systems, focusing on algorithm design, implementation, and result analysis.

Expected Outcomes
Enhanced programming proficiency; improved logical reasoning; effective tool usage; readiness for advanced computing and cyber security courses.

Evaluation Scheme
Continuous Assessment (60%) + End-Semester Practical Examination (40%)

SEMESTER II

Mathematics II (Probability & Statistics)
Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop probabilistic reasoning for uncertainty modeling
2. Apply statistical methods for data analysis
3. Enable quantitative decision making for cyber systems
4. Build analytical foundation for security analytics
5. Prepare students for advanced data driven courses

Course Outcomes
CO1 Apply probability laws to engineering problems
CO2 Analyze random variables and distributions
CO3 Compute statistical measures for datasets
CO4 Apply inferential statistics for decision making
CO5 Integrate probability and statistics in cyber applications

Detailed Syllabus

Unit I
Probability concepts; sample space, events; axioms of probability; conditional probability; Bayes theorem; independence; applications in risk assessment; uncertainty modeling; cyber incident probability analysis; decision support foundations.

Unit II
Random variables; discrete, continuous distributions; probability mass functions; density functions; expectation, variance; binomial, Poisson, normal distributions; modeling of cyber events; traffic analysis; performance evaluation.

Unit III
Joint distributions; marginal, conditional distributions; covariance, correlation; regression concepts; applications in dependency analysis; system behavior modeling; statistical relationships in cyber datasets.

Unit IV
Sampling theory; population, sample statistics; estimation methods; confidence intervals; hypothesis testing; significance levels; error types; applications in security validation; anomaly detection foundations.

Unit V
Statistical quality control; control charts; reliability analysis; time series basics; forecasting

concepts; applications in system monitoring; cyber trend analysis; operational decision making support.

Text Books

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). *Probability and statistics for engineers and scientists* (9th ed.). Pearson.
2. Devore, J. L. (2016). *Probability and statistics for engineering and the sciences* (9th ed.). Cengage.
3. Montgomery, D. C., & Runger, G. C. (2018). *Applied statistics and probability for engineers* (7th ed.). Wiley.
4. Ross, S. M. (2019). *Introduction to probability and statistics for engineers and scientists* (6th ed.). Academic Press.
5. Johnson, R. A., & Bhattacharyya, G. K. (2010). *Statistics: Principles and methods* (6th ed.). Wiley.

Reference Books

1. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2019). *Probability and statistical inference* (10th ed.). Pearson.
2. Papoulis, A., & Pillai, S. U. (2002). *Probability, random variables, and stochastic processes*. McGraw-Hill.
3. Spiegel, M. R., Schiller, J., & Srinivasan, R. (2013). *Probability and statistics* (4th ed.). McGraw-Hill.
4. Freund, J. E., Miller, I., & Miller, M. (2014). *John E. Freund's mathematical statistics*. Pearson.
5. Gupta, S. C., & Kapoor, V. K. (2019). *Fundamentals of mathematical statistics*. Sultan Chand.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Data Structures & Algorithms
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamental data structures
2. Analyze algorithmic efficiency
3. Apply structured problem solving techniques

4. Enable efficient data organization
5. Prepare foundation for advanced computing courses

Course Outcomes
CO1 Implement linear and non linear data structures
CO2 Analyze time and space complexity
CO3 Apply algorithms for searching and sorting
CO4 Solve problems using appropriate data structures
CO5 Relate data structures to cyber applications

Detailed Syllabus

Unit I
Algorithm analysis; time, space complexity; asymptotic notations; arrays, structures; pointers; abstract data types; performance considerations; application relevance to cyber systems.

Unit II
Stacks, queues; operations, implementations; recursion; applications in expression evaluation; system processes; memory usage considerations; algorithm efficiency evaluation.

Unit III
Linked lists; singly, doubly, circular; dynamic memory management; operations; applications in system programming; data organization strategies.

Unit IV
Trees; binary trees; traversal techniques; binary search trees; heaps; priority queues; applications in indexing; hierarchical data modeling.

Unit V
Sorting, searching algorithms; linear, binary search; insertion, selection, quick, merge sort; hashing concepts; performance comparison; cyber data handling applications.

Text Books

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). *Introduction to algorithms* (4th ed.). MIT Press.
2. Weiss, M. A. (2019). *Data structures and algorithm analysis in C* (4th ed.). Pearson.
3. Sahni, S. (2018). *Data structures, algorithms, and applications in C++* (2nd ed.). McGraw-Hill.
4. Horowitz, E., Sahni, S., & Rajasekaran, S. (2014). *Computer algorithms* (2nd ed.). Universities Press.
5. Goodrich, M. T., Tamassia, R., & Goldwasser, M. (2014). *Data structures and algorithms in Python*. Wiley.

Reference Books

1. Aho, A. V., Hopcroft, J. E., & Ullman, J. D. (2014). *Data structures and algorithms*. Pearson.
2. Sedgewick, R., & Wayne, K. (2018). *Algorithms* (4th ed.). Pearson.
3. Lafore, R. (2017). *Data structures and algorithms in Java* (2nd ed.). Pearson.
4. Brassard, G., & Bratley, P. (1996). *Fundamentals of algorithmics*. Prentice Hall.
5. Kleinberg, J., & Tardos, E. (2006). *Algorithm design*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Operating Systems Fundamentals
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand operating system concepts
2. Analyze process and memory management
3. Study file and storage management
4. Introduce system security fundamentals
5. Build base for advanced system courses

Course Outcomes
CO1 Explain operating system functions
CO2 Analyze process scheduling mechanisms
CO3 Understand memory management techniques
CO4 Describe file system organization
CO5 Relate OS concepts to cyber security

Detailed Syllabus

Unit I
Operating system overview; objectives, services; system calls; OS structures; kernel concepts; system booting; resource management foundations; cyber system relevance.

Unit II
Process management; process states; scheduling algorithms; interprocess communication; synchronization basics; deadlocks; performance considerations.

Unit III
Memory management; paging, segmentation; virtual memory; page replacement algorithms; memory protection; efficiency analysis; security implications.

Unit IV
File systems; file organization; directory structures; allocation methods; storage management; disk scheduling; reliability aspects.

Unit V
I O systems; device management; protection, security basics; authentication concepts; access control; system vulnerabilities overview.

Text Books

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2018). *Operating system concepts* (10th ed.). Wiley.
2. Tanenbaum, A. S., & Bos, H. (2015). *Modern operating systems* (4th ed.). Pearson.
3. Stallings, W. (2018). *Operating systems: Internals and design principles* (9th ed.). Pearson.
4. Dhamdhere, D. M. (2017). *Operating systems: A concept-based approach* (3rd ed.). McGraw-Hill.
5. Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C. (2018). *Operating systems: Three easy pieces*. Arpaci-Dusseau Books.

Reference Books

1. Nutt, G. J. (2015). *Operating systems: A modern perspective*. Addison-Wesley.
2. Bach, M. J. (2014). *The design of the UNIX operating system*. Pearson.
3. Love, R. (2010). *Linux kernel development*. Addison-Wesley.
4. Nemeth, E., Snyder, G., Hein, T. R., & Whaley, B. (2017). *UNIX and Linux system administration handbook*. Pearson.
5. Tannenbaum, A. (2015). *Structured computer organization*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Introduction to Cyber Security
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce cyber security fundamentals
2. Understand threat landscape and attacks
3. Study basic defense mechanisms

4. Build awareness of cyber hygiene
5. Prepare base for advanced security courses

Course Outcomes
CO1 Identify cyber threats and vulnerabilities
CO2 Explain security principles and models
CO3 Analyze common cyber attacks
CO4 Apply basic protection mechanisms
CO5 Understand organizational security practices

Detailed Syllabus

Unit I
Cyber security overview; CIA triad; threat landscape; attack surfaces; security objectives; cyber ecosystem; risk fundamentals; security governance basics.

Unit II
Malware types; viruses, worms, trojans; attack vectors; phishing; social engineering; exploitation basics; impact assessment.

Unit III
Network security basics; firewalls; intrusion detection; access control; authentication methods; secure communication principles.

Unit IV
System security; operating system hardening; application security basics; vulnerability management; patching; configuration management.

Unit V
Cyber laws overview; ethics; compliance basics; security policies; incident response fundamentals; cyber awareness practices.

Text Books

1. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.
2. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
3. Whitman, M. E., & Mattord, H. J. (2018). *Principles of information security* (6th ed.). Cengage.
4. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.
5. Pfleeger, C. P., & Pfleeger, S. L. (2015). *Security in computing* (5th ed.). Pearson.

Reference Books

1. Schneier, B. (2015). *Applied cryptography* (2nd ed.). Wiley.
2. Bayuk, J. L., Healey, J., Rohmeyer, P., Sachs, M., Schmidt, J., & Weiss, J. (2012). *Cyber security policy guidebook*. Wiley.

3. Grimes, R. A. (2017). *Hacking the hacker*. Wiley.
4. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
5. Von Solms, R., & Van Niekerk, J. (2013). *Information security governance*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Database Management Systems
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand database concepts and architecture
2. Learn data modeling techniques
3. Apply SQL for data manipulation
4. Introduce transaction management
5. Enable secure data handling

Course Outcomes
CO1 Explain DBMS architecture and components
CO2 Design relational database schemas
CO3 Write SQL queries for data operations
CO4 Understand transactions and concurrency
CO5 Apply database security principles

Detailed Syllabus

Unit I
Database concepts; data models; DBMS architecture; schema, instances; data independence; database users; system environment overview.

Unit II
Relational model; relational algebra; integrity constraints; functional dependencies; normalization; schema refinement; data consistency.

Unit III
SQL basics; DDL, DML; joins; subqueries; views; indexing concepts; query optimization basics.

Unit IV
Transaction management; ACID properties; concurrency control; locking protocols; recovery mechanisms; failure handling.

Unit V
Database security; authorization; authentication; backup, recovery; data privacy; secure database practices; cyber relevance.

Text Books

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2019). *Database system concepts* (7th ed.). McGraw-Hill.
2. Elmasri, R., & Navathe, S. (2017). *Fundamentals of database systems* (7th ed.). Pearson.
3. Coronel, C., & Morris, S. (2018). *Database systems: Design, implementation, and management* (13th ed.). Cengage.
4. Date, C. J. (2019). *An introduction to database systems* (8th ed.). Pearson.
5. Ramakrishnan, R., & Gehrke, J. (2003). *Database management systems* (3rd ed.). McGraw-Hill.

Reference Books

1. Garcia-Molina, H., Ullman, J. D., & Widom, J. (2008). *Database systems: The complete book*. Pearson.
2. Connolly, T., & Begg, C. (2015). *Database systems* (6th ed.). Pearson.
3. Oppel, A. (2019). *SQL: A beginner's guide* (4th ed.). McGraw-Hill.
4. Rob, P., & Coronel, C. (2018). *Database systems: Design, implementation, and management*. Cengage.
5. Mullins, C. S. (2012). *Database administration*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop creative problem solving skills
2. Introduce design thinking methodology
3. Encourage innovation mindset
4. Apply structured ideation techniques
5. Foster teamwork and communication

Course Outcomes
CO1 Apply design thinking principles
CO2 Generate innovative solutions
CO3 Analyze user centric problems
CO4 Work effectively in teams
CO5 Present innovative concepts professionally

Detailed Syllabus

Unit I
Design thinking overview; innovation concepts; creativity fundamentals; problem identification; user centric perspectives; interdisciplinary relevance.

Unit II
Empathy mapping; need analysis; stakeholder identification; contextual inquiry; problem framing techniques.

Unit III
Ideation methods; brainstorming; mind mapping; lateral thinking; concept development; feasibility analysis.

Unit IV
Prototyping basics; low fidelity models; iteration; feedback incorporation; validation methods.

Unit V
Innovation ecosystems; entrepreneurship basics; intellectual property awareness; design ethics; presentation techniques.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.
2. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown Business.
3. Liedtka, J., King, A., & Bennett, K. (2013). *Solving problems with design thinking*. Columbia University Press.
4. Martin, R. L. (2009). *The design of business*. Harvard Business Press.
5. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.

Reference Books

1. IDEO. (2015). *The field guide to human centered design*. IDEO.
2. Kumar, V. (2013). *101 design methods*. Wiley.
3. Cross, N. (2011). *Design thinking*. Berg.
4. Lockwood, T. (2010). *Design thinking*. Allworth Press.

5. Norman, D. A. (2013). *The design of everyday things*. Basic Books.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship / Industrial Orientation
Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industry environment
2. Understand organizational practices
3. Observe real world cyber systems
4. Relate theory to practice
5. Develop professional attitude

Course Outcomes
CO1 Identify industry roles and processes
CO2 Observe cyber systems applications
CO3 Apply academic knowledge in practice
CO4 Demonstrate professional conduct
CO5 Prepare for future internships

Guidelines
Industry orientation through visits, interaction sessions, supervised exposure; documentation of learning activities; adherence to institutional guidelines.

Evaluation Scheme
Continuous Assessment based on report and presentation (100%)

SEMESTER III

Computer Networks & Protocols
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand principles of computer networking and protocols
2. Analyze layered network architectures and services
3. Study data transmission and switching techniques
4. Examine transport and application layer protocols
5. Prepare foundation for network security and forensics

Course Outcomes
CO1 Explain network models and protocol layering
CO2 Analyze data transmission and error control methods
CO3 Describe switching and routing mechanisms
CO4 Understand transport layer services and protocols
CO5 Relate networking concepts to cyber security contexts

Detailed Syllabus

Unit I
Data communication fundamentals; network types; transmission media; bandwidth, latency, throughput; error detection, correction techniques; multiplexing methods; network performance metrics; protocol standards; cyber infrastructure relevance.

Unit II
Network architectures; OSI model; TCP IP model; functions of layers; encapsulation, decapsulation; addressing concepts; protocol interactions; interoperability; service interfaces; layered communication analysis.

Unit III
Data link layer; framing methods; flow control; error control protocols; Ethernet standards; switching concepts; virtual LANs; link layer security considerations; performance evaluation.

Unit IV
Network layer functions; IP addressing; subnetting; routing algorithms; distance vector, link state; IPv4, IPv6; packet forwarding; congestion control overview; scalability considerations.

Unit V
Transport and application layers; TCP, UDP characteristics; flow, congestion control; DNS, HTTP, FTP, SMTP protocols; quality of service concepts; protocol vulnerabilities; network monitoring basics.

Text Books

1. Kurose, J. F., & Ross, K. W. (2021). *Computer networking: A top-down approach* (8th ed.). Pearson.
2. Tanenbaum, A. S., & Wetherall, D. J. (2021). *Computer networks* (6th ed.). Pearson.
3. Forouzan, B. A. (2017). *Data communications and networking* (5th ed.). McGraw-Hill.
4. Stallings, W. (2017). *Data and computer communications* (10th ed.). Pearson.
5. Peterson, L. L., & Davie, B. S. (2020). *Computer networks: A systems approach* (6th ed.). Morgan Kaufmann.

Reference Books

1. Comer, D. E. (2018). *Internetworking with TCP IP* (7th ed.). Pearson.
2. Keshav, S. (2012). *An engineering approach to computer networking*. Addison-Wesley.
3. Stevens, W. R. (1994). *TCP IP illustrated, Volume 1*. Addison-Wesley.
4. Lewis, T. G. (2018). *Network science: Theory and applications*. Wiley.
5. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Cryptography & Network Security
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand cryptographic principles and algorithms
2. Analyze symmetric and asymmetric encryption techniques
3. Study authentication and key management mechanisms
4. Examine network security protocols
5. Apply cryptography in cyber security scenarios

Course Outcomes
CO1 Explain classical and modern cryptographic concepts
CO2 Apply symmetric and asymmetric algorithms
CO3 Analyze hashing and digital signature techniques

CO4 Understand secure communication protocols
CO5 Relate cryptography to network security applications

Detailed Syllabus

Unit I
Cryptography fundamentals; security goals; classical ciphers; substitution, transposition; cryptanalysis concepts; key management basics; randomness; computational security assumptions; cyber relevance.

Unit II
Symmetric key cryptography; block, stream ciphers; DES, AES overview; modes of operation; key distribution issues; performance considerations; implementation aspects.

Unit III
Asymmetric cryptography; RSA, Diffie Hellman; elliptic curve basics; public key infrastructure; digital certificates; trust models; computational complexity considerations.

Unit IV
Hash functions; message authentication codes; integrity mechanisms; digital signatures; authentication protocols; non repudiation; secure hashing applications.

Unit V
Network security protocols; SSL TLS; IPsec; secure email; wireless security basics; attacks, countermeasures; protocol vulnerabilities; deployment considerations.

Text Books

1. Stallings, W. (2018). *Cryptography and network security* (7th ed.). Pearson.
2. Katz, J., & Lindell, Y. (2020). *Introduction to modern cryptography* (3rd ed.). CRC Press.
3. Paar, C., & Pelzl, J. (2010). *Understanding cryptography*. Springer.
4. Schneier, B. (2015). *Applied cryptography* (2nd ed.). Wiley.
5. Menezes, A. J., Van Oorschot, P. C., & Vanstone, S. A. (2018). *Handbook of applied cryptography*. CRC Press.

Reference Books

1. Kaufman, C., Perlman, R., & Speciner, M. (2015). *Network security* (2nd ed.). Pearson.
2. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.
3. Ferguson, N., Schneier, B., & Kohno, T. (2010). *Cryptography engineering*. Wiley.
4. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
5. Mao, W. (2004). *Modern cryptography*. Prentice Hall.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Web Technologies & Security
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand web architecture and technologies
2. Analyze client server communication models
3. Study web application development basics
4. Examine common web security vulnerabilities
5. Apply secure web design principles

Course Outcomes
CO1 Explain web architecture and protocols
CO2 Develop basic web applications
CO3 Identify web vulnerabilities and threats
CO4 Apply secure coding practices for web systems
CO5 Relate web technologies to cyber investigations

Detailed Syllabus

Unit I
Web fundamentals; client server architecture; HTTP, HTTPS protocols; URLs; request response cycle; web servers; browsers; session management concepts; performance considerations.

Unit II
HTML, CSS basics; document structure; forms; client side scripting overview; JavaScript fundamentals; dynamic content generation; usability considerations.

Unit III
Server side technologies overview; scripting languages; databases integration; session handling; cookies; authentication mechanisms; application workflow.

Unit IV
Web security threats; SQL injection; cross site scripting; cross site request forgery; authentication flaws; vulnerability assessment basics; secure coding awareness.

Unit V
Web security controls; input validation; access control; secure session management; HTTPS deployment; web application firewalls; security testing overview.

Text Books

1. Ullman, L. (2018). *PHP and MySQL for dynamic web sites* (5th ed.). Peachpit Press.
2. Deitel, P., & Deitel, H. (2017). *Internet and World Wide Web how to program* (5th ed.). Pearson.
3. Sullivan, B., & Liu, V. (2011). *Web application security*. McGraw-Hill.
4. Stuttard, D., & Pinto, M. (2018). *The web application hacker's handbook* (2nd ed.). Wiley.
5. Freeman, E., & Freeman, E. (2018). *Head first HTML and CSS* (2nd ed.). O'Reilly Media.

Reference Books

1. Grannell, C. (2016). *CSS3 visual quickstart guide*. Peachpit Press.
2. McLaughlin, B. (2011). *PHP and MySQL web development*. Addison-Wesley.
3. Rescorla, E. (2018). *The transport layer security protocol*. Addison-Wesley.
4. OWASP Foundation. (2021). *OWASP top ten*. OWASP.
5. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Forensics Fundamentals
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of digital forensics
2. Understand forensic investigation processes
3. Study digital evidence types and handling
4. Examine forensic tools and techniques
5. Prepare foundation for advanced forensic courses

Course Outcomes
CO1 Explain digital forensic concepts and scope
CO2 Identify and classify digital evidence
CO3 Apply forensic investigation methodologies
CO4 Understand forensic tools and procedures
CO5 Relate forensics to cyber crime investigations

Detailed Syllabus

Unit I
Digital forensics overview; objectives; forensic science principles; investigation lifecycle; legal considerations; evidence integrity; chain of custody; forensic readiness concepts.

Unit II
Digital evidence types; volatile, non volatile data; evidence identification; acquisition methods; imaging techniques; hashing; documentation practices.

Unit III
File systems overview; FAT, NTFS basics; file allocation; metadata; deleted file recovery concepts; timeline analysis; storage structures.

Unit IV
Operating system forensics; Windows, Linux basics; registry analysis; log files; user activity artifacts; system timeline reconstruction.

Unit V
Network and mobile forensics overview; email, browser artifacts; incident response linkage; reporting fundamentals; expert testimony basics.

Text Books

1. Casey, E. (2011). *Digital evidence and computer crime* (3rd ed.). Academic Press.
2. Nelson, B., Phillips, A., & Steuart, C. (2019). *Guide to computer forensics and investigations* (6th ed.). Cengage.
3. Carrier, B. (2005). *File system forensic analysis*. Addison-Wesley.
4. Sammons, J. (2015). *The basics of digital forensics*. Syngress.
5. Beebe, N. L., & Clark, J. G. (2005). *Digital forensic text and workbook*. Pearson.

Reference Books

1. Kruse, W. G., & Heiser, J. G. (2014). *Computer forensics: Incident response essentials*. Addison-Wesley.
2. Mandia, K., Prosise, C., & Pepe, M. (2014). *Incident response and computer forensics*. McGraw-Hill.
3. Farmer, D., & Venema, W. (2005). *Forensic discovery*. Addison-Wesley.
4. Rogers, M. K. (2016). *Digital forensic investigation*. CRC Press.
5. Jones, K. J., Bejtlich, R., & Rose, C. (2005). *Real digital forensics*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Secure Programming Practices
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Promote secure coding principles
2. Identify common programming vulnerabilities
3. Apply defensive programming techniques
4. Understand software security lifecycle
5. Reduce risk of exploitable software flaws

Course Outcomes
CO1 Identify insecure coding patterns
CO2 Apply secure coding standards
CO3 Analyze software vulnerabilities
CO4 Implement defensive programming controls
CO5 Relate secure coding to cyber resilience

Detailed Syllabus

Unit I
Secure programming overview; threat modeling basics; attack surface concepts; secure software principles; least privilege; defense in depth; coding standards awareness.

Unit II
Input validation issues; buffer overflows; integer errors; memory safety concerns; exception handling; error management; secure coding practices.

Unit III
Authentication, authorization flaws; session management issues; access control logic; secure design patterns; privilege management.

Unit IV
Secure coding for web and system applications; common vulnerability classes; misuse cases; code review techniques; static analysis overview.

Unit V
Secure software lifecycle; testing strategies; vulnerability disclosure; patch management; secure deployment practices; compliance considerations.

Text Books

1. McGraw, G. (2006). *Software security*. Addison-Wesley.
2. Howard, M., & LeBlanc, D. (2002). *Writing secure code* (2nd ed.). Microsoft Press.
3. Viega, J., & McGraw, G. (2001). *Building secure software*. Addison-Wesley.

4. Seacord, R. C. (2013). *Secure coding in C and C++* (2nd ed.). Addison-Wesley.
5. Chess, B., & West, J. (2007). *Secure programming with static analysis*. Addison-Wesley.

Reference Books

1. OWASP Foundation. (2021). *OWASP top ten*. OWASP.
2. Wheeler, D. A. (2011). *Secure programming for Linux and Unix*. Addison-Wesley.
3. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
4. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.
5. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Ethics / Indian Constitution)
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop ethical awareness and civic responsibility
2. Understand constitutional values and rights
3. Promote professional and social ethics
4. Encourage responsible citizenship
5. Integrate ethics with cyber professional practice

Course Outcomes
CO1 Explain ethical principles and values
CO2 Understand constitutional provisions and governance
CO3 Apply ethics in professional contexts
CO4 Analyze social and legal responsibilities
CO5 Demonstrate responsible citizenship behavior

Detailed Syllabus

Unit I
Ethics fundamentals; values; moral reasoning; professional ethics; ethical dilemmas; decision making frameworks; societal relevance.

Unit II
Indian Constitution overview; preamble; fundamental rights; duties; directive principles; governance structure.

Unit III
Justice; liberty; equality; fraternity; constitutional amendments; democratic institutions; rule of law concepts.

Unit IV
Ethics in technology; cyber ethics; privacy; intellectual property; professional responsibility; regulatory awareness.

Unit V
Social responsibility; citizenship; leadership ethics; sustainability; inclusive development; national integration.

Text Books

1. Austin, G. (2016). *The Indian Constitution: Cornerstone of a nation*. Oxford University Press.
2. Fieser, J. (2015). *Ethics: Discovering right and wrong* (7th ed.). Cengage.
3. Subba Rao, B. (2017). *Ethics, integrity and aptitude*. McGraw-Hill.
4. Basu, D. D. (2018). *Introduction to the Constitution of India* (23rd ed.). LexisNexis.
5. Rachels, J., & Rachels, S. (2019). *The elements of moral philosophy* (9th ed.). McGraw-Hill.

Reference Books

1. Velasquez, M. G. (2017). *Business ethics* (8th ed.). Pearson.
2. Sarkar, S. (2014). *Our Constitution*. National Book Trust.
3. Sen, A. (2009). *The idea of justice*. Harvard University Press.
4. Rawls, J. (1999). *A theory of justice*. Harvard University Press.
5. Singer, P. (2011). *Practical ethics*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship
Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide industry exposure in cyber and forensic domains
2. Apply academic knowledge to practical environments
3. Understand professional workflows and standards
4. Develop workplace communication and ethics
5. Prepare for advanced internships and projects

Course Outcomes
CO1 Observe industry level cyber operations
CO2 Apply theoretical concepts in practice
CO3 Document professional learning outcomes
CO4 Demonstrate professional conduct
CO5 Evaluate career pathways in cyber systems

Guidelines
Supervised industrial attachment; activity log maintenance; learning outcome documentation; compliance with institutional and industry norms.

Evaluation Scheme
Continuous Assessment based on report and evaluation (100%)

SEMESTER IV

Cyber Crime Investigation Techniques
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand cyber crime landscape and typologies
2. Develop investigation methodology aligned with legal processes
3. Analyze digital evidence acquisition and preservation
4. Apply investigative tools and techniques
5. Integrate technical findings with legal reporting

Course Outcomes
CO1 Identify cyber crime categories and modus operandi
CO2 Apply structured investigation processes
CO3 Preserve and analyze digital evidence
CO4 Utilize investigative tools appropriately
CO5 Prepare compliant investigation reports

Detailed Syllabus

Unit I
Cyber crime overview; classification, motivations; cyber offenders, victims; crime lifecycle; digital footprints; investigative challenges; jurisdictional issues; cyber policing structures; reporting mechanisms; case initiation procedures.

Unit II
Investigation methodology; incident identification; scoping, planning; evidence sources; volatile, non volatile data; first responder actions; scene management; legal authorizations; documentation standards; chain of custody practices.

Unit III
Evidence acquisition techniques; live, dead acquisition; imaging tools; hashing methods; integrity verification; storage media handling; mobile, network sources; triage concepts; prioritization strategies; forensic readiness.

Unit IV
Analysis techniques; timeline construction; artifact correlation; user attribution; network traffic analysis; log interpretation; malware indicators; reconstruction methods; hypothesis validation; analytical rigor.

Unit V
Legal procedures; admissibility standards; expert testimony; report structuring; presentation

of findings; coordination with law enforcement; court processes; ethical considerations; compliance with cyber laws.

Text Books

1. Nelson, B., Phillips, A., & Steuart, C. (2019). *Guide to computer forensics and investigations* (6th ed.). Cengage.
2. Casey, E. (2011). *Digital evidence and computer crime* (3rd ed.). Academic Press.
3. Mandia, K., Prosise, C., & Pepe, M. (2014). *Incident response and computer forensics* (3rd ed.). McGraw-Hill.
4. Sammons, J. (2015). *The basics of digital forensics*. Syngress.
5. Rogers, M. K. (2016). *Digital forensic investigation*. CRC Press.

Reference Books

1. Kruse, W. G., & Heiser, J. G. (2014). *Computer forensics: Incident response essentials*. Addison-Wesley.
2. Jones, K. J., Bejtlich, R., & Rose, C. (2005). *Real digital forensics*. Addison-Wesley.
3. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
4. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
5. Von Solms, R., & Van Niekerk, J. (2013). *Information security governance*. Springer.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

System & Network Forensics
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand system and network forensic principles
2. Analyze operating system artifacts
3. Examine network based evidence sources
4. Apply forensic tools for analysis
5. Correlate system and network findings

Course Outcomes
CO1 Identify system forensic artifacts
CO2 Analyze operating system level evidence

CO3 Interpret network forensic data
CO4 Apply forensic tools for investigation
CO5 Correlate multi source forensic evidence

Detailed Syllabus

Unit I
System forensics fundamentals; host based evidence; volatile data sources; memory artifacts; process information; persistence mechanisms; system timelines; forensic acquisition planning.

Unit II
Windows forensics; registry structures; event logs; file system artifacts; user activity traces; prefetch, jump lists; analysis techniques; attribution considerations.

Unit III
Linux forensics; file system layouts; log files; process artifacts; user activity traces; shell history; configuration analysis; timeline reconstruction.

Unit IV
Network forensics basics; packet capture; flow records; log sources; intrusion indicators; session reconstruction; protocol analysis; traffic correlation techniques.

Unit V
Integrated analysis; correlation of host, network artifacts; incident reconstruction; reporting standards; validation methods; limitations; forensic accuracy assurance.

Text Books

1. Carrier, B. (2005). *File system forensic analysis*. Addison-Wesley.
2. Beebe, N. L., & Clark, J. G. (2005). *Digital forensic text and workbook*. Pearson.
3. Jones, K. J., Bejtlich, R., & Rose, C. (2005). *Real digital forensics*. Addison-Wesley.
4. Mandia, K., Prosise, C., & Pepe, M. (2014). *Incident response and computer forensics*. McGraw-Hill.
5. Nelson, B., Phillips, A., & Steuart, C. (2019). *Guide to computer forensics and investigations* (6th ed.). Cengage.

Reference Books

1. Farmer, D., & Venema, W. (2005). *Forensic discovery*. Addison-Wesley.
2. Kruse, W. G., & Heiser, J. G. (2014). *Computer forensics: Incident response essentials*. Addison-Wesley.
3. Casey, E. (2011). *Digital evidence and computer crime*. Academic Press.
4. Rogers, M. K. (2016). *Digital forensic investigation*. CRC Press.

5. Sammons, J. (2015). *The basics of digital forensics*. Syngress.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Malware Analysis & Reverse Engineering
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand malware types and behaviors
2. Analyze static and dynamic malware characteristics
3. Apply reverse engineering fundamentals
4. Identify indicators of compromise
5. Support incident response and forensics

Course Outcomes
CO1 Classify malware and attack vectors
CO2 Perform static malware analysis
CO3 Conduct dynamic analysis safely
CO4 Extract indicators of compromise
CO5 Relate malware findings to investigations

Detailed Syllabus

Unit I
Malware overview; classification; propagation methods; infection vectors; payload behaviors; persistence techniques; command control concepts; threat actor objectives; analysis prerequisites.

Unit II
Static analysis techniques; file formats; hashes; strings analysis; disassembly concepts; signatures; obfuscation methods; limitations; safe handling practices.

Unit III
Dynamic analysis; sandboxing; behavioral monitoring; API calls; network activity observation; debugging basics; environment setup; risk mitigation.

Unit IV
Reverse engineering fundamentals; assembly basics; control flow analysis; unpacking techniques; code modification awareness; anti analysis tactics.

Unit V
Indicators of compromise; detection strategies; reporting standards; threat intelligence linkage; remediation support; lessons learned; ethical considerations.

Text Books

1. Sikorski, M., & Honig, A. (2012). *Practical malware analysis*. No Starch Press.
2. Szor, P. (2005). *The art of computer virus research and defense*. Addison-Wesley.
3. Eilam, E. (2011). *Reversing: Secrets of reverse engineering*. Wiley.
4. Ligh, M. H., Adair, S., Hartstein, B., & Richard, M. (2014). *Malware analyst's cookbook*. Wiley.
5. Schultz, E., & Peruski, L. (2016). *Malware: Fighting malicious code*. McGraw-Hill.

Reference Books

1. Zeltser, L. (2017). *Malware analysis handbook*. SANS Institute.
2. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
3. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
4. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.
5. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Cloud Computing & Cloud Security
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand cloud computing architectures and models
2. Analyze virtualization and service delivery mechanisms
3. Study cloud security risks and controls
4. Apply security best practices in cloud environments
5. Integrate cloud concepts with cyber investigations

Course Outcomes
CO1 Explain cloud service and deployment models
CO2 Analyze virtualization and resource management
CO3 Identify cloud security threats

CO4 Apply cloud security controls
CO5 Relate cloud systems to forensic readiness

Detailed Syllabus

Unit I
Cloud computing fundamentals; characteristics; service models; deployment models; cloud architectures; resource pooling; elasticity; scalability; economic considerations.

Unit II
Virtualization concepts; hypervisors; virtual machines; containers overview; orchestration basics; performance considerations; isolation mechanisms.

Unit III
Cloud infrastructure services; compute, storage, networking; identity access management; shared responsibility model; configuration practices.

Unit IV
Cloud security threats; data breaches; misconfigurations; insider risks; encryption practices; key management; monitoring strategies.

Unit V
Cloud forensics basics; evidence sources; logging mechanisms; incident response; compliance requirements; data residency; audit considerations.

Text Books

1. Mell, P., & Grance, T. (2011). *The NIST definition of cloud computing*. NIST.
2. Buyya, R., Broberg, J., & Goscinski, A. (2011). *Cloud computing*. Wiley.
3. Krutz, R. L., & Vines, R. D. (2010). *Cloud security*. Wiley.
4. Subashini, S., & Kavitha, V. (2011). *A survey on security issues in cloud computing*. Journal of Network and Computer Applications.
5. Rittinghouse, J. W., & Ransome, J. F. (2017). *Cloud computing*. CRC Press.

Reference Books

1. CSA. (2019). *Cloud security guidance*. Cloud Security Alliance.
2. Antonopoulos, N., & Gillam, L. (2017). *Cloud computing*. Springer.
3. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
4. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
5. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I (IoT Security / Mobile Computing)
Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fundamentals of IoT or mobile computing
2. Analyze security challenges in connected systems
3. Study architectures and communication models
4. Apply security controls for constrained environments
5. Integrate emerging technologies with cyber security

Course Outcomes
CO1 Explain IoT or mobile system architectures
CO2 Identify security threats and vulnerabilities
CO3 Analyze protocols and communication models
CO4 Apply security mechanisms in practice
CO5 Relate emerging systems to cyber risk

Detailed Syllabus

Unit I
IoT or mobile computing overview; architectures; components; communication models; protocols; system constraints; application domains; threat landscape.

Unit II
Sensors, devices; operating environments; connectivity technologies; data flows; middleware concepts; performance considerations.

Unit III
Security challenges; device authentication; secure communication; access control; firmware security; update mechanisms.

Unit IV
Attack vectors; device compromise; network attacks; privacy issues; risk mitigation strategies; monitoring approaches.

Unit V
Standards; regulatory considerations; secure deployment practices; case studies; future trends; ethical implications.

Text Books

1. Roman, R., Zhou, J., & Lopez, J. (2013). *On the features and challenges of security and privacy in distributed IoT*. Computer Networks.
2. Stallings, W. (2018). *Effective cyber security*. Addison-Wesley.

3. Kahn Academy. (2019). *Mobile computing fundamentals*. McGraw-Hill.
4. Conti, M. (2017). *Security and privacy in mobile IoT*. Springer.
5. Al-Fuqaha, A., et al. (2015). *Internet of Things: A survey*. IEEE Communications Surveys.

Reference Books

1. Buyya, R., & Dastjerdi, A. V. (2016). *Internet of Things*. Morgan Kaufmann.
2. Zhang, Y., & Chen, Y. (2019). *Security and privacy in mobile communications*. Springer.
3. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
4. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
5. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Cyber Forensics Laboratory
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop hands on forensic investigation skills
2. Apply forensic tools for evidence analysis
3. Practice acquisition and preservation techniques
4. Perform structured forensic reporting
5. Reinforce theory through practical exercises

Course Outcomes
CO1 Acquire digital evidence using forensic tools
CO2 Analyze system and network artifacts
CO3 Maintain evidence integrity and documentation
CO4 Interpret forensic findings accurately
CO5 Prepare professional forensic reports

List of Experiments / Exercises

1. Preparation of forensic workstation and write blocker configuration, including tool setup, environment hardening, and verification of forensic readiness.

2. Acquisition of disk images using forensic imaging tools, including hashing, integrity verification, and documentation of chain of custody.
3. Analysis of file systems to identify deleted files and artifacts, using forensic suites and structured examination methodologies.
4. Examination of Windows registry and event logs to reconstruct user activity and system events.
5. Linux system forensic analysis focusing on log files, configuration artifacts, and user activity traces.
6. Memory acquisition and analysis to identify running processes, network connections, and potential malware indicators.
7. Network traffic capture and analysis using packet analysis tools to identify suspicious communications and intrusion indicators.
8. Email and browser artifact analysis to trace communication activities and user behavior patterns.
9. Mobile device forensic overview exercise focusing on data extraction methods and legal considerations.
10. Integrated forensic case exercise combining acquisition, analysis, reporting, and presentation of findings.
11. Validation of forensic findings through cross tool comparison and error checking.
12. Preparation of structured forensic report adhering to legal and professional standards.

Expected Outcomes
Hands on forensic proficiency; tool competence; evidence integrity assurance; analytical accuracy; professional reporting capability.

Evaluation Scheme
Continuous Assessment (60%) + End-Semester Practical Examination (40%)

Internship
Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Extend industry exposure in cyber and forensic domains
2. Apply advanced concepts in practical settings
3. Observe professional investigative workflows
4. Develop analytical and reporting skills

5. Prepare for final year projects

Course Outcomes
CO1 Participate in supervised industry activities
CO2 Apply semester level knowledge in practice
CO3 Document professional learning outcomes
CO4 Demonstrate ethical and professional conduct
CO5 Align internship experience with career goals

Guidelines
Supervised industrial engagement; activity documentation; mentor evaluation; institutional compliance; presentation of learning outcomes.

Evaluation Scheme
Continuous Assessment based on report and evaluation (100%)

SEMESTER V

Ethical Hacking & Penetration Testing
Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand ethical hacking principles and legal boundaries
2. Analyze penetration testing methodologies and phases
3. Identify vulnerabilities across systems and networks
4. Apply assessment tools and techniques responsibly
5. Prepare structured vulnerability and risk reports

Course Outcomes
CO1 Explain ethical hacking concepts and compliance requirements
CO2 Apply penetration testing frameworks and workflows
CO3 Identify and assess system vulnerabilities
CO4 Utilize testing tools for controlled assessments
CO5 Document findings with mitigation recommendations

Detailed Syllabus

Unit I
Ethical hacking fundamentals; threat landscape; legal, ethical considerations; penetration testing scope; reconnaissance concepts; information gathering techniques; attack surface mapping; rules of engagement; professional standards.

Unit II
Footprinting techniques; active, passive reconnaissance; scanning methodologies; network discovery; service enumeration; vulnerability identification; assessment planning; accuracy validation; reporting inputs.

Unit III
System hacking concepts; authentication weaknesses; password attacks; privilege escalation; maintaining access awareness; lateral movement; persistence indicators; logging implications; defensive countermeasures.

Unit IV
Web application testing; common vulnerabilities; injection flaws; authentication bypass; session weaknesses; security misconfigurations; testing methodologies; exploitation validation; remediation prioritization.

Unit V
Wireless, cloud, social engineering overview; phishing mechanics; physical security

awareness; post exploitation activities; cleanup procedures; report writing standards; risk scoring; compliance alignment.

Text Books

1. Walker, M. (2019). *CEH certified ethical hacker all-in-one exam guide* (4th ed.). McGraw-Hill.
2. Engebretson, P. (2013). *The basics of hacking and penetration testing* (2nd ed.). Syngress.
3. Weidman, G. (2014). *Penetration testing: A hands-on introduction to hacking*. No Starch Press.
4. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
5. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.

Reference Books

1. Stuttard, D., & Pinto, M. (2018). *The web application hacker's handbook* (2nd ed.). Wiley.
2. Hadnagy, C. (2018). *Social engineering: The science of human hacking* (2nd ed.). Wiley.
3. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.
4. OWASP Foundation. (2021). *OWASP testing guide*. OWASP.
5. NIST. (2018). *Technical guide to information security testing and assessment*. NIST.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Mobile & Wireless Forensics
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand mobile and wireless forensic principles
2. Identify data artifacts in mobile devices
3. Apply acquisition techniques for mobile evidence
4. Analyze wireless communication traces
5. Integrate findings with forensic reporting

Course Outcomes
CO1 Identify mobile device architectures and artifacts
CO2 Perform mobile data acquisition methods
CO3 Analyze wireless communication evidence
CO4 Maintain evidence integrity and documentation
CO5 Prepare structured mobile forensic reports

Detailed Syllabus

Unit I
Mobile forensics overview; device architectures; operating systems; data storage; SIM concepts; acquisition challenges; legal considerations; chain of custody; investigative scope.

Unit II
Data acquisition methods; logical, physical extraction; backup analysis; file system artifacts; application data; metadata interpretation; integrity verification.

Unit III
Android forensics basics; file systems; application artifacts; logs; permissions; user activity traces; timeline reconstruction; analysis tools.

Unit IV
iOS forensics basics; data protection mechanisms; backups; application artifacts; logs; encryption considerations; acquisition limitations.

Unit V
Wireless forensics; Wi Fi, Bluetooth traces; packet capture; location data; correlation with mobile artifacts; reporting standards; evidentiary challenges.

Text Books

1. Hoog, A. (2011). *Android forensics*. Syngress.
2. Levinson, A. (2019). *Mobile forensics*. CRC Press.
3. Casey, E. (2011). *Digital evidence and computer crime* (3rd ed.). Academic Press.
4. Sammons, J. (2015). *The basics of digital forensics*. Syngress.
5. Nelson, B., Phillips, A., & Steuart, C. (2019). *Guide to computer forensics and investigations* (6th ed.). Cengage.

Reference Books

1. Zdziarski, J. (2014). *iPhone forensic analysis*. O'Reilly Media.
2. Beebe, N. L., & Clark, J. G. (2005). *Digital forensic text and workbook*. Pearson.
3. Rogers, M. K. (2016). *Digital forensic investigation*. CRC Press.
4. Mandia, K., Prosise, C., & Pepe, M. (2014). *Incident response and computer forensics*. McGraw-Hill.

5. Kruse, W. G., & Heiser, J. G. (2014). *Computer forensics: Incident response essentials*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Blockchain Technology & Security
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand blockchain fundamentals and architectures
2. Analyze consensus mechanisms and cryptographic foundations
3. Study smart contracts and platforms
4. Examine blockchain security risks and controls
5. Relate blockchain systems to forensic analysis

Course Outcomes
CO1 Explain blockchain components and data structures
CO2 Analyze consensus algorithms and performance
CO3 Understand smart contract platforms
CO4 Identify blockchain security threats
CO5 Relate blockchain evidence to investigations

Detailed Syllabus

Unit I
Blockchain fundamentals; distributed ledgers; blocks, chains; hashing; immutability; decentralization concepts; trust models; application domains; system characteristics.

Unit II
Consensus mechanisms; proof of work; proof of stake; byzantine fault tolerance; scalability issues; performance tradeoffs; network considerations.

Unit III
Cryptographic foundations; public key cryptography; hashing algorithms; digital signatures; wallet concepts; key management; transaction integrity.

Unit IV
Smart contracts; platforms overview; execution models; vulnerabilities; reentrancy; logic flaws; auditing concepts; secure development practices.

Unit V
Blockchain security; attacks; 51 percent risk; privacy issues; forensic challenges; transaction analysis; regulatory considerations; compliance awareness.

Text Books

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and cryptocurrency technologies*. Princeton University Press.
2. Antonopoulos, A. M. (2017). *Mastering Bitcoin* (2nd ed.). O'Reilly Media.
3. Bashir, I. (2018). *Mastering blockchain* (2nd ed.). Packt.
4. Drescher, D. (2017). *Blockchain basics*. Apress.
5. Swan, M. (2015). *Blockchain*. O'Reilly Media.

Reference Books

1. Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2018). *An overview of blockchain technology*. IEEE.
2. Conti, M., Kumar, S., Lal, C., & Ruj, S. (2018). *A survey on security and privacy issues of bitcoin*. IEEE.
3. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
4. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
5. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Cyber Law, Policy & Governance
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand cyber laws and regulatory frameworks
2. Analyze national and international cyber policies
3. Study governance and compliance requirements
4. Examine legal processes in cyber cases
5. Integrate legal awareness with cyber practice

Course Outcomes
CO1 Explain cyber laws and legal provisions

CO2 Analyze policy and governance structures
CO3 Understand compliance and regulatory obligations
CO4 Relate legal procedures to cyber investigations
CO5 Apply legal awareness in professional practice

Detailed Syllabus

Unit I
Cyber law overview; legal principles; jurisdiction; cyber offenses; investigation powers; evidence admissibility; procedural requirements; compliance awareness.

Unit II
Information Technology Act; provisions; amendments; offenses, penalties; adjudication; enforcement mechanisms; case analysis.

Unit III
Cyber policies; national cyber security policy; data protection concepts; privacy frameworks; international perspectives; governance models.

Unit IV
Intellectual property rights; copyright; patents; trademarks; cyber space relevance; infringement issues; enforcement mechanisms.

Unit V
Cyber governance; standards; compliance; risk management; incident disclosure; ethics; regulatory coordination; future directions.

Text Books

1. Duggal, P. (2017). *Cyber law in India*. Universal Law Publishing.
2. Sharma, S. K. (2018). *Cyber laws and information technology*. Oxford University Press.
3. Basu, D. D. (2018). *Introduction to the Constitution of India* (23rd ed.). LexisNexis.
4. Reed, C., & Angel, J. (2016). *Computer law* (7th ed.). Oxford University Press.
5. Bainbridge, D. (2018). *Introduction to computer law* (8th ed.). Pearson.

Reference Books

1. Spinello, R. A. (2017). *Cyberethics*. Jones & Bartlett.
2. Tavani, H. T. (2016). *Ethics and technology* (5th ed.). Wiley.
3. Solove, D. J. (2011). *Nothing to hide*. Yale University Press.
4. Sen, A. (2009). *The idea of justice*. Harvard University Press.
5. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I (AI in Cyber Security / Financial Forensics)
Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce advanced elective domain concepts
2. Analyze application oriented methodologies
3. Apply analytical techniques to cyber scenarios
4. Integrate tools and frameworks
5. Prepare specialization oriented skills

Course Outcomes
CO1 Explain elective domain foundations
CO2 Apply analytical techniques effectively
CO3 Analyze domain specific case studies
CO4 Utilize tools relevant to specialization
CO5 Relate elective knowledge to professional practice

Detailed Syllabus

Unit I
AI in cyber security or financial forensics overview; domain scope; application areas; data sources; analytical objectives; system constraints.

Unit II
Machine learning or forensic analytics basics; feature extraction; model selection; performance evaluation; data quality considerations.

Unit III
Threat detection or financial anomaly analysis; pattern recognition; classification techniques; validation approaches; operational deployment.

Unit IV
Tool ecosystems; platforms; integration challenges; scalability considerations; ethical implications; governance awareness.

Unit V
Case studies; industry practices; regulatory considerations; emerging trends; research directions; professional skill alignment.

Text Books

1. Sommer, R., & Paxson, V. (2010). *Outside the closed world*. IEEE.
2. Bolstad, W. (2017). *Introduction to Bayesian statistics*. Wiley.
3. Aggarwal, C. C. (2018). *Neural networks and deep learning*. Springer.
4. Hopwood, W., Leiner, J., & Young, G. (2011). *Forensic accounting*. McGraw-Hill.
5. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.

Reference Books

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
2. Chandola, V., Banerjee, A., & Kumar, V. (2009). *Anomaly detection*. ACM.
3. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.
4. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
5. Casey, E. (2011). *Digital evidence and computer crime* (3rd ed.). Academic Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project (Cyber Security / Forensic Case Study)
Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply cumulative knowledge to a focused problem
2. Develop analytical and implementation skills
3. Practice documentation and presentation standards
4. Encourage independent and team based work
5. Prepare foundation for major project

Course Outcomes
CO1 Identify problem statements and objectives
CO2 Apply tools and methodologies appropriately
CO3 Analyze results and validate findings
CO4 Document project work systematically
CO5 Present outcomes professionally

Guidelines
Problem identification; literature review; methodology selection; implementation or analysis; periodic reviews; report preparation; presentation and evaluation.

Evaluation Scheme
Continuous Assessment based on reviews and final evaluation (100%)

SEMESTER VI

Advanced Threat Intelligence & Incident Response
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand advanced cyber threat landscapes and adversaries
2. Analyze threat intelligence lifecycle and sources
3. Apply structured incident response methodologies
4. Correlate intelligence with detection and response
5. Strengthen organizational cyber resilience capabilities

Course Outcomes
CO1 Explain threat intelligence concepts and frameworks
CO2 Analyze indicators and threat actor behaviors
CO3 Apply incident response phases effectively
CO4 Correlate intelligence with security operations
CO5 Prepare actionable response and mitigation plans

Detailed Syllabus

Unit I
Cyber threat landscape; advanced persistent threats; threat actors, motivations; attack campaigns; intelligence driven security; strategic, tactical, operational intelligence; cyber kill chain; threat modeling foundations; organizational context.

Unit II
Threat intelligence lifecycle; planning, collection; open source, commercial feeds; data normalization; enrichment techniques; confidence scoring; information sharing standards; intelligence quality assessment.

Unit III
Indicators of compromise; tactics, techniques, procedures; behavioral analysis; correlation methods; threat hunting concepts; detection engineering; false positive reduction; contextual analysis approaches.

Unit IV
Incident response lifecycle; preparation; detection, analysis; containment strategies; eradication, recovery; coordination mechanisms; communication protocols; documentation standards; lessons learned integration.

Unit V
Security operations integration; SOC workflows; automation concepts; orchestration tools;

metrics, maturity models; continuous improvement; regulatory alignment; cyber resilience enhancement strategies.

Text Books

1. Hutchins, E. M., Cloppert, M. J., & Amin, R. M. (2011). *Intelligence-driven computer network defense*. Lockheed Martin.
2. Skoudis, E., & Liston, T. (2019). *Counter hack redux*. Pearson.
3. Bejtlich, R. (2013). *The practice of network security monitoring*. No Starch Press.
4. Sanders, C. (2017). *Applied network security monitoring*. Syngress.
5. Casey, E. (2011). *Digital evidence and computer crime* (3rd ed.). Academic Press.

Reference Books

1. Mandia, K., Prosise, C., & Pepe, M. (2014). *Incident response and computer forensics*. McGraw-Hill.
2. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
3. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.
4. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
5. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Evidence Management & Reporting
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand digital evidence lifecycle management
2. Apply standards for evidence handling and storage
3. Develop forensic documentation and reporting skills
4. Ensure legal admissibility and integrity
5. Strengthen expert communication capabilities

Course Outcomes
CO1 Explain digital evidence types and lifecycle
CO2 Apply proper evidence handling procedures
CO3 Maintain integrity and chain of custody

CO4 Prepare structured forensic reports
CO5 Present evidence in legal and professional contexts

Detailed Syllabus

Unit I
Digital evidence concepts; evidentiary principles; relevance, reliability; admissibility criteria; forensic standards; lifecycle management; ethical obligations; professional responsibilities.

Unit II
Evidence identification; collection procedures; labeling; packaging; storage requirements; environmental controls; access management; documentation practices; audit trails.

Unit III
Chain of custody management; transfer records; verification methods; integrity assurance; hashing applications; evidence tracking systems; compliance requirements.

Unit IV
Forensic reporting standards; report structure; technical writing; clarity, objectivity; visualization techniques; appendices; peer review; quality assurance processes.

Unit V
Expert testimony basics; courtroom procedures; presentation skills; cross examination awareness; legal communication; confidentiality; professional conduct; continuous improvement.

Text Books

1. Casey, E. (2011). *Digital evidence and computer crime* (3rd ed.). Academic Press.
2. Nelson, B., Phillips, A., & Steuart, C. (2019). *Guide to computer forensics and investigations* (6th ed.). Cengage.
3. Rogers, M. K. (2016). *Digital forensic investigation*. CRC Press.
4. Sammons, J. (2015). *The basics of digital forensics*. Syngress.
5. Jones, K. J., Bejtlich, R., & Rose, C. (2005). *Real digital forensics*. Addison-Wesley.

Reference Books

1. Kruse, W. G., & Heiser, J. G. (2014). *Computer forensics: Incident response essentials*. Addison-Wesley.
2. Farmer, D., & Venema, W. (2005). *Forensic discovery*. Addison-Wesley.
3. Mandia, K., Prosise, C., & Pepe, M. (2014). *Incident response and computer forensics*. McGraw-Hill.
4. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
5. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Emerging Trends in Cyber Systems & Forensics
Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Explore emerging cyber technologies and threats
2. Analyze evolving forensic challenges
3. Understand future oriented security paradigms
4. Encourage research and innovation awareness
5. Align skills with industry evolution

Course Outcomes
CO1 Identify emerging cyber system trends
CO2 Analyze novel threat vectors
CO3 Understand future forensic methodologies
CO4 Evaluate impact of new technologies
CO5 Prepare for continuous professional development

Detailed Syllabus

Unit I
Emerging cyber technologies; artificial intelligence security; automation; cyber physical systems; convergence trends; threat evolution; adaptive defenses; innovation drivers.

Unit II
Advanced malware trends; fileless attacks; supply chain compromises; zero trust concepts; attack surface expansion; defensive implications; monitoring challenges.

Unit III
Cloud native forensics; container environments; virtualization artifacts; serverless computing; evidence sources; logging evolution; forensic readiness considerations.

Unit IV
IoT, OT forensics; constrained devices; data acquisition challenges; protocol diversity; scalability issues; privacy implications; regulatory awareness.

Unit V
Future directions; quantum computing impact; post quantum cryptography; regulatory evolution; skills roadmap; ethical considerations; research opportunities.

Text Books

1. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.
2. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
3. Stallings, W. (2018). *Effective cyber security*. Addison-Wesley.
4. Conti, M. (2017). *Security and privacy in mobile IoT*. Springer.
5. Bishop, M. (2019). *Computer security: Art and science* (2nd ed.). Pearson.

Reference Books

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
2. Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2018). *An overview of blockchain technology*. IEEE.
3. Roman, R., Zhou, J., & Lopez, J. (2013). *Security and privacy in distributed IoT*. Computer Networks.
4. Solove, D. J. (2011). *Nothing to hide*. Yale University Press.
5. Sen, A. (2009). *The idea of justice*. Harvard University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II (Cyber Risk Management / Privacy Engineering)
Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand risk management or privacy engineering principles
2. Analyze frameworks and standards
3. Apply assessment and mitigation techniques
4. Integrate governance with technical controls
5. Strengthen compliance oriented skills

Course Outcomes
CO1 Explain risk or privacy frameworks
CO2 Identify and assess organizational risks
CO3 Apply mitigation and control strategies
CO4 Analyze compliance and governance requirements
CO5 Relate elective knowledge to cyber practice

Detailed Syllabus

Unit I
Cyber risk management or privacy engineering overview; scope; objectives; governance models; stakeholder roles; organizational context; regulatory landscape.

Unit II
Risk assessment methods; asset identification; threat analysis; vulnerability evaluation; impact analysis; likelihood estimation; prioritization techniques.

Unit III
Risk treatment or privacy by design; control selection; technical, administrative safeguards; data minimization; secure processing concepts.

Unit IV
Standards, frameworks; ISO, NIST; compliance requirements; audits; metrics; reporting mechanisms; continuous monitoring.

Unit V
Case studies; industry practices; emerging challenges; automation; future trends; ethical considerations; professional skill alignment.

Text Books

1. ISO. (2018). *ISO/IEC 27005 information security risk management*. ISO.
2. NIST. (2018). *Risk management framework*. NIST.
3. Solove, D. J., & Schwartz, P. M. (2020). *Information privacy law*. Wolters Kluwer.
4. Gellman, R., & Dixon, P. (2011). *Privacy by design*. World Privacy Forum.
5. Behl, A., & Behl, K. (2017). *Cyberwar*. Oxford University Press.

Reference Books

1. Calder, A. (2018). *IT governance*. Kogan Page.
2. Anderson, R. (2020). *Security engineering* (3rd ed.). Wiley.
3. Stallings, W. (2018). *Network security essentials* (6th ed.). Pearson.
4. Tavani, H. T. (2016). *Ethics and technology* (5th ed.). Wiley.
5. Sen, A. (2009). *The idea of justice*. Harvard University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project (Industry / Research Based)
Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Solve complex cyber or forensic problems
2. Apply research or industry methodologies
3. Develop implementation and analysis competence
4. Strengthen documentation and presentation skills
5. Demonstrate professional and ethical standards

Course Outcomes
CO1 Define problem statements and objectives
CO2 Apply appropriate tools and methodologies
CO3 Analyze results critically
CO4 Document work systematically
CO5 Present project outcomes professionally

Guidelines
Problem definition; literature review; methodology design; implementation or analysis; evaluation; report submission; project demonstration; viva voce examination.

Evaluation Scheme
Continuous Assessment and Final Evaluation (100%)

Seminar / Viva-Voce
Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop research presentation skills
2. Enhance technical communication competence
3. Encourage independent learning
4. Assess conceptual understanding
5. Prepare for professional evaluations

Course Outcomes
CO1 Review contemporary topics critically
CO2 Organize technical content effectively
CO3 Deliver structured presentations

CO4 Respond to technical queries confidently
CO5 Demonstrate comprehensive subject understanding

Guidelines
Topic selection; literature survey; seminar report; presentation delivery; questioning; assessment by panel; viva voce evaluation.

Evaluation Scheme
Continuous Assessment based on seminar and viva voce (100%)

M.Sc. (Research) – Foundation Models & Domain-Specific LLMs

Duration: 2Years | 4 SEMESTER s | Total Credits: 80

SEMESTER I

Advanced Mathematics for Machine Learning

Course Category
Basic Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Linear algebra foundations for machine learning models
2. Multivariable calculus for optimization frameworks
3. Probability theory for stochastic modeling
4. Matrix methods for high dimensional data analysis
5. Mathematical rigor for algorithmic convergence analysis

Course Outcomes
CO1 Apply linear algebra concepts in ML models
CO2 Use calculus for optimization problems
CO3 Analyze probabilistic ML formulations
CO4 Employ matrix methods in data representation
CO5 Evaluate mathematical properties of learning algorithms

Detailed Syllabus

Unit I
Vector spaces, subspaces, basis, dimension; linear independence, span; inner product spaces, norms, orthogonality; projections, Gram–Schmidt process; eigenvalues, eigenvectors; spectral decomposition; positive definite matrices; relevance to feature spaces, dimensionality reduction, learning representations.

Unit II
Functions of several variables, limits, continuity; partial derivatives, gradients, Jacobians, Hessians; Taylor series approximation; convex functions, convex sets; constrained and unconstrained optimization; Lagrange multipliers; applications to loss minimization, parameter estimation, learning stability.

Unit III
Random variables, probability spaces, distributions; expectation, variance, covariance; joint,

marginal, conditional distributions; Bayes theorem; common distributions, Gaussian, Bernoulli, multinomial; law of large numbers; central limit theorem; probabilistic modeling for machine learning inference.

Unit IV
Matrix calculus, derivatives of vectors and matrices; trace, determinant identities; quadratic forms; matrix norms; singular value decomposition; pseudoinverse; conditioning; numerical stability; applications to least squares, regularization, low rank approximation, learning algorithm efficiency.

Unit V
Information theory basics; entropy, joint and conditional entropy; mutual information; Kullback–Leibler divergence; cross entropy; maximum likelihood estimation; maximum entropy principle; connections to loss functions, generalization, uncertainty quantification in learning systems.

Text Books

1. Boyd, S., & Vandenberghe, L. (2004). *Convex optimization*. Cambridge University Press.
2. Strang, G. (2016). *Introduction to linear algebra* (5th ed.). Wellesley-Cambridge Press.
3. Murphy, K. P. (2022). *Probabilistic machine learning: An introduction*. MIT Press.
4. Petersen, K. B., & Pedersen, M. S. (2012). *The matrix cookbook*. Technical University of Denmark.
5. Cover, T. M., & Thomas, J. A. (2012). *Elements of information theory* (2nd ed.). Wiley.

Reference Books

1. Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
2. Hastie, T., Tibshirani, R., & Friedman, J. (2017). *The elements of statistical learning*. Springer.
3. Higham, N. J. (2002). *Accuracy and stability of numerical algorithms*. SIAM.
4. Jaynes, E. T. (2003). *Probability theory: The logic of science*. Cambridge University Press.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Statistical Learning Theory

Course Category
Engineering Science Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Theoretical foundations of machine learning
2. Generalization and complexity analysis
3. Risk minimization frameworks
4. Probabilistic bounds for learning models
5. Statistical guarantees for algorithms

Course Outcomes
CO1 Analyze learning from data principles
CO2 Evaluate generalization performance
CO3 Apply risk minimization concepts
CO4 Interpret learning bounds
CO5 Assess statistical validity of models

Detailed Syllabus

Unit I
Learning paradigms, supervised, unsupervised, semi supervised; hypothesis spaces; training and testing frameworks; loss functions; empirical risk minimization; inductive bias; consistency; bias variance tradeoff; role of statistics in predictive modeling.

Unit II
Generalization theory; overfitting, underfitting; uniform convergence; concentration inequalities; Hoeffding, Chebyshev, Chernoff bounds; sample complexity; confidence intervals; probabilistic guarantees for learning algorithms under finite data regimes.

Unit III
VC dimension; shattering; growth functions; Sauer lemma; structural risk minimization; capacity control; margin based classifiers; implications for model selection, complexity regulation, classifier robustness in high dimensional learning spaces.

Unit IV
Bayesian learning theory; prior, likelihood, posterior; MAP, MLE estimation; Bayesian risk; posterior predictive distribution; conjugate priors; hierarchical models; uncertainty estimation; comparison with frequentist learning approaches.

Unit V
Online learning theory; regret minimization; adversarial settings; stochastic optimization;

PAC learning framework; stability theory; algorithmic robustness; theoretical analysis of modern large scale learning systems.

Text Books

1. Vapnik, V. N. (1998). *Statistical learning theory*. Wiley.
2. Shalev-Shwartz, S., & Ben-David, S. (2014). *Understanding machine learning*. Cambridge University Press.
3. Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
4. Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2018). *Foundations of machine learning* (2nd ed.). MIT Press.
5. Hastie, T., Tibshirani, R., & Friedman, J. (2017). *The elements of statistical learning*. Springer.

Reference Books

1. Kearns, M., & Vazirani, U. (1994). *An introduction to computational learning theory*. MIT Press.
2. Devroye, L., Györfi, L., & Lugosi, G. (2013). *A probabilistic theory of pattern recognition*. Springer.
3. Bousquet, O., & Elisseeff, A. (2002). Stability and generalization. *Journal of Machine Learning Research*, 2, 499–526.
4. Cesa-Bianchi, N., & Lugosi, G. (2006). *Prediction, learning, and games*. Cambridge University Press.
5. Murphy, K. P. (2022). *Probabilistic machine learning*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Foundations of Artificial Intelligence

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Conceptual foundations of artificial intelligence
2. Problem solving and search strategies
3. Knowledge representation techniques

4. Reasoning under uncertainty
5. Intelligent agent architectures

Course Outcomes
CO1 Explain core AI concepts
CO2 Apply search algorithms
CO3 Represent knowledge formally
CO4 Analyze reasoning methods
CO5 Design intelligent agents

Detailed Syllabus

Unit I
History of artificial intelligence; intelligent agents; environments; rationality; problem formulation; state space representation; performance measures; task environments; AI application domains; relationship with machine learning and cognitive systems.

Unit II
Uninformed search strategies; breadth first, depth first, uniform cost; informed search; heuristics; greedy best first; A star algorithm; optimality, completeness, complexity analysis; applications to planning and decision problems.

Unit III
Knowledge representation; propositional logic; predicate logic; syntax, semantics; inference rules; resolution; unification; knowledge bases; reasoning mechanisms; limitations of logical reasoning in real world intelligent systems.

Unit IV
Planning systems; classical planning; state space planning; goal stack planning; STRIPS representation; constraint satisfaction problems; backtracking; local search; applications in scheduling, robotics, automated reasoning tasks.

Unit V
Reasoning under uncertainty; probability theory in AI; Bayesian networks; conditional independence; inference algorithms; decision theory; utility functions; Markov decision processes; reinforcement learning overview; intelligent sequential decision making.

Text Books

1. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
2. Poole, D., & Mackworth, A. (2017). *Artificial intelligence: Foundations of computational agents* (2nd ed.). Cambridge University Press.
3. Nilsson, N. J. (2014). *Principles of artificial intelligence*. Morgan Kaufmann.
4. Pearl, J. (1988). *Probabilistic reasoning in intelligent systems*. Morgan Kaufmann.

5. Luger, G. F. (2008). *Artificial intelligence: Structures and strategies for complex problem solving* (6th ed.). Pearson.

Reference Books

1. Rich, E., Knight, K., & Nair, S. B. (2010). *Artificial intelligence* (3rd ed.). McGraw-Hill.
2. Russell, S. (2019). *Human compatible*. Viking.
3. Sutton, R. S., & Barto, A. G. (2018). *Reinforcement learning* (2nd ed.). MIT Press.
4. Koller, D., & Friedman, N. (2009). *Probabilistic graphical models*. MIT Press.
5. Winston, P. H. (1992). *Artificial intelligence*. Addison-Wesley.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Deep Learning Architectures

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Neural network fundamentals
2. Deep architecture design principles
3. Optimization of deep models
4. Regularization and generalization methods
5. Application of deep learning frameworks

Course Outcomes
CO1 Understand neural architectures
CO2 Train deep learning models
CO3 Apply optimization techniques
CO4 Control overfitting in deep networks
CO5 Evaluate deep learning applications

Detailed Syllabus

Unit I
Artificial neural networks; perceptron model; activation functions; multilayer networks;

forward propagation; loss functions; representational capacity; universal approximation; deep versus shallow models; neural computation fundamentals.

Unit II
Backpropagation algorithm; gradient descent variants; stochastic optimization; learning rates; momentum; adaptive methods; initialization strategies; vanishing and exploding gradients; training stability issues in deep architectures.

Unit III
Regularization techniques; L1, L2 penalties; dropout; batch normalization; early stopping; data augmentation; bias variance tradeoff; generalization in deep networks; empirical risk behavior with large models.

Unit IV
Convolutional neural networks; convolution operation; pooling; padding; stride; hierarchical feature learning; architectures, LeNet, AlexNet, VGG; applications in vision, pattern recognition, representation learning tasks.

Unit V
Recurrent neural networks; sequence modeling; backpropagation through time; LSTM, GRU architectures; attention overview; encoder decoder models; applications in language modeling, speech processing, time series analysis.

Text Books

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
2. Nielsen, M. A. (2015). *Neural networks and deep learning*. Determination Press.
3. Chollet, F. (2021). *Deep learning with Python* (2nd ed.). Manning.
4. Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
5. Aggarwal, C. C. (2018). *Neural networks and deep learning*. Springer.

Reference Books

1. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, 521, 436–444.
2. Schmidhuber, J. (2015). Deep learning in neural networks. *Neural Networks*, 61, 85–117.
3. Patterson, J., & Gibson, A. (2017). *Deep learning*. O'Reilly.
4. Prince, S. J. D. (2023). *Understanding deep learning*. MIT Press.
5. Zhang, A., Lipton, Z. C., Li, M., & Smola, A. (2023). *Dive into deep learning*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Programming for AI Systems (Python & PyTorch)

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Python programming for AI workflows
2. Numerical computing for ML
3. PyTorch based model development
4. Software practices for AI systems
5. Integration of data and models

Course Outcomes
CO1 Develop Python based AI programs
CO2 Implement numerical ML components
CO3 Build models using PyTorch
CO4 Apply software engineering practices
CO5 Integrate end to end AI pipelines

Detailed Syllabus

Unit I
Python programming fundamentals; data types; control structures; functions; object oriented concepts; modules; exception handling; file operations; scientific Python ecosystem; relevance to artificial intelligence development workflows.

Unit II
Numerical computing; NumPy arrays; vectorization; broadcasting; linear algebra operations; random number generation; performance considerations; SciPy overview; data preprocessing for machine learning pipelines.

Unit III
Data handling and visualization; Pandas data frames; indexing, merging, aggregation; handling missing values; Matplotlib, Seaborn visualization basics; exploratory data analysis for AI applications.

Unit IV
PyTorch fundamentals; tensors; computational graphs; automatic differentiation; model definition; loss functions; optimizers; training loops; GPU acceleration; debugging deep learning programs.

Unit V
Model deployment basics; saving and loading models; experiment management;

reproducibility; software versioning; testing; integration with data pipelines; performance profiling; scalable AI system development practices.

Text Books

1. VanderPlas, J. (2016). *Python data science handbook*. O'Reilly.
2. McKinney, W. (2017). *Python for data analysis* (2nd ed.). O'Reilly.
3. Stevens, E., Antiga, L., & Viehmann, T. (2020). *Deep learning with PyTorch*. Manning.
4. Raschka, S., Patterson, J., & Nolet, C. (2022). *Machine learning with PyTorch and Scikit-Learn*. Packt.
5. Downey, A. B. (2015). *Think Python* (2nd ed.). O'Reilly.

Reference Books

1. Lutz, M. (2013). *Learning Python* (5th ed.). O'Reilly.
2. Géron, A. (2022). *Hands-on machine learning* (3rd ed.). O'Reilly.
3. Paszke, A., et al. (2019). PyTorch. *NeurIPS*.
4. Brownlee, J. (2020). *Deep learning for computer vision*. Machine Learning Mastery.
5. Wilson, G., et al. (2014). *Best practices for scientific computing*. PLOS Biology.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Research Methodology & Scientific Writing

Course Category
Humanities & Management Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Research problem identification
2. Scientific methodology understanding
3. Literature review techniques
4. Academic writing skills
5. Research ethics and integrity

Course Outcomes
CO1 Formulate research problems
CO2 Apply scientific methods
CO3 Conduct structured literature reviews
CO4 Produce scholarly manuscripts
CO5 Follow ethical research practices

Detailed Syllabus

Unit I
Nature of research; scientific thinking; types of research; basic, applied, exploratory; research process; hypothesis formulation; variables; research design overview; relevance to engineering and AI research.

Unit II
Literature survey methods; scholarly databases; citation indexing; systematic review techniques; research gap identification; critical reading; organizing references; bibliographic management tools.

Unit III
Research methodologies; quantitative, qualitative, mixed methods; experimental design; data collection techniques; sampling methods; validity, reliability; statistical considerations in empirical research.

Unit IV
Scientific writing principles; structure of research papers; abstracts; introductions; methodology sections; results, discussions; figures, tables; referencing styles; plagiarism awareness; academic integrity.

Unit V
Research ethics; authorship; peer review process; reproducibility; data management; intellectual property basics; research proposals; funding awareness; responsible conduct of research in AI.

Text Books

1. Kothari, C. R. (2004). *Research methodology* (2nd ed.). New Age International.
2. Creswell, J. W. (2014). *Research design* (4th ed.). Sage.
3. Booth, W. C., Colomb, G. G., & Williams, J. M. (2016). *The craft of research* (4th ed.). University of Chicago Press.
4. Day, R. A., & Gastel, B. (2012). *How to write and publish a scientific paper* (7th ed.). Cambridge University Press.
5. American Psychological Association. (2020). *Publication manual of the APA* (7th ed.).

Reference Books

1. Zobel, J. (2014). *Writing for computer science* (3rd ed.). Springer.
2. Resnik, D. B. (2015). *The ethics of science*. Routledge.
3. Hart, C. (2018). *Doing a literature review*. Sage.
4. Alley, M. (2013). *The craft of scientific writing* (4th ed.). Springer.
5. Elsevier. (2023). *Researcher academy resources*. Elsevier.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Laboratory / Tool Practicum (AI Frameworks)

Course Category
Engineering Science Course

Credits / Contact Hours
1 Credit / 15 Contact Hours

Course Objectives

1. Practical exposure to AI frameworks
2. Tool based implementation skills
3. Experimentation with ML workflows
4. Debugging and evaluation practices
5. Hands on model execution

Course Outcomes
CO1 Operate AI development environments
CO2 Implement ML workflows using tools
CO3 Execute training and evaluation tasks
CO4 Analyze experimental results
CO5 Document practical AI experiments

List of Experiments / Exercises

1. Installation and configuration of Python, Conda, and Jupyter environments, including package management, virtual environments, and verification of scientific libraries for AI development readiness.
2. Implementation of linear regression using NumPy, focusing on data loading, matrix operations, loss computation, and evaluation of numerical stability.
3. Data preprocessing using Pandas, including cleaning, normalization, feature encoding, and preparation of datasets for machine learning tasks.

4. Visualization of datasets using Matplotlib and Seaborn, emphasizing interpretation of patterns, distributions, and correlations relevant to AI models.
5. Implementation of a basic neural network in PyTorch, covering tensor operations, forward pass definition, and loss evaluation.
6. Training a PyTorch model using gradient descent, including optimizer configuration, learning rate selection, and monitoring convergence behavior.
7. Evaluation of trained models using accuracy and loss metrics, including train test split and performance interpretation.
8. Experimentation with GPU acceleration in PyTorch, focusing on device management and computational efficiency comparison.
9. Saving, loading, and reusing trained models, emphasizing reproducibility and experiment management practices.
10. Mini project integrating data preprocessing, model training, evaluation, and reporting using AI frameworks.

Expected Outcomes
Hands on proficiency in AI tools; practical understanding of ML workflows; ability to execute, evaluate, and document AI experiments systematically.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER II

Natural Language Processing

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Linguistic foundations for language processing
2. Statistical and neural NLP techniques
3. Text representation and feature extraction
4. Language modeling and sequence learning
5. Evaluation of NLP systems

Course Outcomes
CO1 Analyze linguistic structures computationally
CO2 Apply statistical NLP methods
CO3 Implement neural NLP models
CO4 Construct language models
CO5 Evaluate NLP applications

Detailed Syllabus

Unit I
Introduction to natural language processing; linguistic levels, phonetics, morphology, syntax, semantics, pragmatics; corpus linguistics; text normalization; tokenization; stemming; lemmatization; stop word handling; challenges of ambiguity, sparsity, multilingual language processing.

Unit II
Statistical NLP foundations; n gram language models; smoothing techniques; maximum likelihood estimation; perplexity; hidden Markov models; part of speech tagging; sequence labeling; Viterbi algorithm; probabilistic parsing; limitations of classical statistical methods.

Unit III
Vector space models; bag of words; TF IDF weighting; word co occurrence matrices; dimensionality reduction; latent semantic analysis; distributional semantics; similarity measures; document representation; information retrieval foundations for text based systems.

Unit IV
Neural NLP models; feedforward networks for text; word embeddings; Word2Vec, GloVe;

contextual representations overview; recurrent neural networks for sequences; LSTM, GRU; encoder decoder frameworks; neural sequence modeling principles.

Unit V
NLP applications; text classification; sentiment analysis; named entity recognition; machine translation overview; question answering basics; summarization; evaluation metrics, BLEU, ROUGE, accuracy, F1 score; ethical considerations in language technologies.

Text Books

1. Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing* (3rd ed.). Pearson.
2. Eisenstein, J. (2019). *Introduction to natural language processing*. MIT Press.
3. Goldberg, Y. (2017). *Neural network methods for natural language processing*. Morgan & Claypool.
4. Manning, C. D., Raghavan, P., & Schütze, H. (2008). *Introduction to information retrieval*. Cambridge University Press.
5. Bird, S., Klein, E., & Loper, E. (2009). *Natural language processing with Python*. O'Reilly.

Reference Books

1. Cambria, E., & White, B. (2014). Jumping NLP curves. *IEEE Computational Intelligence Magazine*, 9(2), 48–57.
2. Young, T., et al. (2018). Recent trends in deep learning based NLP. *IEEE Computational Intelligence Magazine*, 13(3), 55–75.
3. Mikolov, T., et al. (2013). Distributed representations. *NeurIPS*.
4. Goldberg, Y. (2016). A primer on neural networks. *Journal of Artificial Intelligence Research*, 57, 345–420.
5. Koehn, P. (2020). *Neural machine translation*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Transformer Architectures & Attention Models

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Attention mechanisms fundamentals
2. Transformer model architecture
3. Training and scaling transformers
4. Pretraining and fine tuning strategies
5. Analysis of transformer based systems

Course Outcomes
CO1 Explain attention mechanisms
CO2 Design transformer architectures
CO3 Train transformer models
CO4 Apply fine tuning techniques
CO5 Evaluate transformer performance

Detailed Syllabus

Unit I
Motivation for attention; limitations of recurrent models; alignment mechanisms; additive and multiplicative attention; self attention concept; query key value formulation; computational characteristics; relevance to sequence modeling and representation learning.

Unit II
Transformer architecture; encoder decoder structure; multi head attention; positional encoding; residual connections; layer normalization; feedforward sublayers; architectural hyperparameters; information flow in deep transformer stacks.

Unit III
Training transformers; optimization challenges; learning rate schedules; warmup strategies; regularization; label smoothing; batch sizing; parallelization; memory considerations; convergence behavior in large scale transformer training.

Unit IV
Pretrained transformer models; BERT, GPT, T5 overview; masked language modeling; autoregressive modeling; sequence to sequence pretraining; transfer learning paradigms; task specific adaptation; representation reuse across tasks.

Unit V
Advanced topics; long sequence transformers; sparse attention; efficient attention variants;

scaling laws; interpretability of attention weights; evaluation benchmarks; societal impact and risks of large transformer models.

Text Books

1. Vaswani, A., et al. (2017). Attention is all you need. *NeurIPS*.
2. Rogers, A., Kovaleva, O., & Rumshisky, A. (2020). Primer in BERTology. *ACL*.
3. Tunstall, L., von Werra, L., & Wolf, T. (2022). *Natural language processing with transformers*. O'Reilly.
4. Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing* (3rd ed.). Pearson.
5. Goldberg, Y. (2017). *Neural network methods for NLP*. Morgan & Claypool.

Reference Books

1. Brown, T., et al. (2020). Language models are few shot learners. *NeurIPS*.
2. Devlin, J., et al. (2019). BERT. *NAACL*.
3. Raffel, C., et al. (2020). Exploring limits of transfer learning. *JMLR*.
4. Tay, Y., et al. (2022). Efficient transformers survey. *ACM Computing Surveys*.
5. Kaplan, J., et al. (2020). Scaling laws for neural language models. *arXiv*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Representation Learning & Embeddings

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Principles of representation learning
2. Embedding techniques for data
3. Neural representation models
4. Evaluation of learned representations
5. Application of embeddings

Course Outcomes
CO1 Understand representation learning theory
CO2 Generate embeddings for data
CO3 Train representation models
CO4 Evaluate embedding quality
CO5 Apply embeddings in downstream tasks

Detailed Syllabus

Unit I
Representation learning motivation; feature engineering limitations; distributed representations; latent variable models; autoencoders overview; manifold hypothesis; representation quality; invariance and disentanglement concepts.

Unit II
Word and sentence embeddings; Word2Vec architectures; CBOW, skip gram; negative sampling; GloVe methodology; fastText; contextual embeddings overview; comparison of static and dynamic representations.

Unit III
Autoencoders; sparse autoencoders; denoising autoencoders; variational autoencoders; latent space properties; reconstruction loss; regularization; representation smoothness; generative interpretation.

Unit IV
Graph and relational embeddings; node embeddings; DeepWalk; Node2Vec; knowledge graph embeddings; translational models; representation of structured data; applications in reasoning and recommendation.

Unit V
Evaluation of representations; intrinsic evaluation; extrinsic evaluation; probing tasks; visualization techniques; transferability; bias in embeddings; fairness considerations; role in foundation model performance.

Text Books

1. Bengio, Y., Courville, A., & Vincent, P. (2013). Representation learning. *IEEE TPAMI*.
2. Goldberg, Y. (2017). *Neural network methods for NLP*. Morgan & Claypool.
3. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
4. Aggarwal, C. C. (2018). *Neural networks and deep learning*. Springer.
5. Nickel, M., Murphy, K., Tresp, V., & Gabrilovich, E. (2016). Knowledge graph embeddings. *IEEE*.

Reference Books

1. Mikolov, T., et al. (2013). Efficient estimation of word representations. *ICLR*.
2. Kingma, D. P., & Welling, M. (2014). Auto encoding variational Bayes. *ICLR*.
3. Grover, A., & Leskovec, J. (2016). Node2Vec. *KDD*.
4. Arora, S., et al. (2016). Simple but tough to beat baselines. *ICLR*.
5. Ethayarajh, K. (2019). Contextual embeddings analysis. *EMNLP*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Scalable Machine Learning Systems

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Large scale ML system design
2. Distributed training principles
3. Data and model scalability
4. Performance optimization strategies
5. Reliable ML system deployment

Course Outcomes
CO1 Design scalable ML systems
CO2 Apply distributed training methods
CO3 Manage large scale data pipelines
CO4 Optimize ML performance
CO5 Evaluate system reliability

Detailed Syllabus

Unit I
Machine learning systems overview; scalability challenges; data volume, velocity, variety; system architectures; batch versus streaming; model lifecycle; integration with software systems; reproducibility and maintainability concerns.

Unit II
Distributed computing foundations; data parallelism; model parallelism; parameter servers; synchronous and asynchronous updates; communication overheads; fault tolerance; consistency models; large scale optimization behavior.

Unit III
Scalable data pipelines; feature stores; data ingestion; preprocessing at scale; distributed storage systems; training data management; experiment tracking; metadata handling; pipeline orchestration concepts.

Unit IV
Hardware acceleration; GPUs, TPUs overview; memory management; mixed precision training; performance profiling; bottleneck analysis; optimization libraries; energy efficiency considerations in large scale training.

Unit V
Deployment and monitoring; model serving architectures; latency and throughput tradeoffs; monitoring drift; logging; versioning; rollback strategies; reliability engineering; operational considerations for production ML systems.

Text Books

1. Zaharia, M., et al. (2018). *Spark: The definitive guide*. O'Reilly.
2. Huyen, C. (2022). *Designing machine learning systems*. O'Reilly.
3. Dean, J., & Ghemawat, S. (2008). MapReduce. *Communications of the ACM*.
4. Patterson, D., et al. (2021). Carbon footprint of ML. *Communications of the ACM*.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Reference Books

1. Abadi, M., et al. (2016). TensorFlow. *OSDI*.
2. Li, M., et al. (2014). Scaling distributed ML. *OSDI*.
3. Chen, T., et al. (2016). MXNet. *arXiv*.
4. Zhang, C., et al. (2019). ML systems challenges. *IEEE*.
5. Breck, E., et al. (2017). ML test scores. *NeurIPS*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Vision-Language Models / Multimodal AI)

Course Category
Professional Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Multimodal learning principles
2. Vision language representation models
3. Cross modal alignment techniques
4. Training multimodal architectures
5. Evaluation of multimodal systems

Course Outcomes
CO1 Understand multimodal learning foundations
CO2 Design vision language models
CO3 Apply cross modal learning techniques
CO4 Train multimodal architectures
CO5 Evaluate multimodal applications

Detailed Syllabus

Unit I
Multimodal learning overview; vision language interaction; modality representations; fusion strategies; early, late, hybrid fusion; challenges of alignment; datasets; applications in perception and reasoning.

Unit II
Vision models foundations; convolutional networks; vision transformers overview; image feature extraction; visual representation learning; pretrained vision encoders; transfer learning for visual modalities.

Unit III
Language models for multimodality; text encoders; contextual representations; alignment objectives; contrastive learning; joint embedding spaces; semantic grounding; multimodal pretraining strategies.

Unit IV
Vision language architectures; CLIP; ViLBERT; VisualBERT; encoder fusion models; cross attention mechanisms; multimodal transformers; training pipelines; scalability considerations.

Unit V
Applications and evaluation; image captioning; visual question answering; retrieval tasks;

multimodal benchmarks; robustness issues; bias and fairness; ethical implications of multimodal AI systems.

Text Books

1. Baltrusaitis, T., Ahuja, C., & Morency, L. P. (2019). Multimodal ML survey. *IEEE TPAMI*.
2. Tan, H., & Bansal, M. (2019). LXMERT. *EMNLP*.
3. Radford, A., et al. (2021). CLIP. *ICML*.
4. Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing*. Pearson.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Reference Books

1. Lu, J., et al. (2019). ViLBERT. *NeurIPS*.
2. Li, L. H., et al. (2020). VisualBERT. *arXiv*.
3. Alayrac, J. B., et al. (2022). Flamingo. *NeurIPS*.
4. Chen, Y. C., et al. (2020). UNITER. *ECCV*.
5. Kiela, D., et al. (2020). Multimodal benchmarks. *ACL*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Advanced AI Laboratory (Model Training & Evaluation)

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Advanced model training skills
2. Experimental evaluation techniques
3. Hyperparameter optimization practices
4. Benchmark driven experimentation
5. Documentation of AI experiments

Course Outcomes
CO1 Train advanced AI models

CO2 Evaluate model performance rigorously
CO3 Optimize hyperparameters
CO4 Conduct benchmark experiments
CO5 Report experimental findings

List of Experiments / Exercises

1. Implementation and training of a transformer based language model using standard datasets, focusing on architecture configuration, training stability, and loss convergence analysis.
2. Fine tuning of pretrained transformer models for text classification tasks, emphasizing transfer learning, parameter freezing, and performance comparison.
3. Hyperparameter optimization using grid and random search, including learning rate, batch size, and optimizer selection for deep models.
4. Evaluation of language models using perplexity, accuracy, and F1 metrics, including dataset splitting and statistical comparison.
5. Training word and sentence embedding models, analyzing embedding quality through similarity and downstream task performance.
6. Experimentation with regularization techniques, including dropout and weight decay, and observing generalization effects.
7. Distributed training experiment using data parallelism, focusing on speedup, scalability, and communication overhead.
8. Model robustness testing using noisy and adversarial inputs, analyzing failure patterns and stability.
9. Model checkpointing, logging, and experiment tracking using standardized tools for reproducibility.
10. Mini project integrating model training, evaluation, benchmarking, and structured reporting.

Expected Outcomes
Advanced proficiency in model training; ability to evaluate and optimize AI systems; structured experimentation and reporting skills.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER III

Foundation Models & Large Language Models

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Architectural foundations of large scale models
2. Pretraining paradigms for foundation models
3. Scaling principles and data considerations
4. Capabilities and limitations of LLMs
5. Evaluation and benchmarking of foundation models

Course Outcomes
CO1 Analyze foundation model architectures
CO2 Apply pretraining methodologies
CO3 Interpret scaling behaviors
CO4 Evaluate capabilities and risks
CO5 Assess benchmark performance

Detailed Syllabus

Unit I
Foundation models concept; emergence of large language models; architectural evolution from neural language models; parameter scaling; data centric learning; compute requirements; training objectives; general purpose representations; task agnostic pretraining principles.

Unit II
Pretraining datasets; web scale corpora; data curation; filtering strategies; tokenization schemes; subword models; vocabulary design; multilingual considerations; data imbalance; quality control; impact of data diversity on learned representations.

Unit III
Training objectives; autoregressive modeling; masked language modeling; span corruption; causal attention; optimization challenges; gradient stability; checkpointing; distributed training; memory efficiency; convergence behavior in large parameter regimes.

Unit IV
Capabilities of LLMs; in context learning; zero shot, few shot behaviors; reasoning patterns;

knowledge representation; hallucination issues; robustness; bias amplification; limitations in grounding and factual consistency.

Unit V
Evaluation frameworks; intrinsic benchmarks; downstream task suites; generalization testing; robustness analysis; safety evaluation; interpretability challenges; societal impact; deployment considerations for large scale foundation models.

Text Books

1. Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing* (3rd ed.). Pearson.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
3. Rogers, A., Kovaleva, O., & Rumshisky, A. (2020). Primer in BERTology. *ACL*.
4. Brown, T., et al. (2020). Language models are few shot learners. *NeurIPS*.
5. Kaplan, J., et al. (2020). Scaling laws for neural language models. *arXiv*.

Reference Books

1. Bommasani, R., et al. (2021). On the opportunities and risks of foundation models. *arXiv*.
2. Rae, J. W., et al. (2021). Scaling language models. *DeepMind*.
3. Chowdhery, A., et al. (2022). PaLM. *arXiv*.
4. Hoffmann, J., et al. (2022). Training compute optimal LLMs. *arXiv*.
5. Liang, P., et al. (2022). Holistic evaluation of language models. *arXiv*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Domain-Specific LLMs (Healthcare / Finance / Law / Engineering)

Course Category
Core Engineering Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Domain adaptation principles for LLMs
2. Specialized data and knowledge integration
3. Task specific fine tuning strategies

4. Evaluation in regulated domains
5. Risk mitigation in domain deployments

Course Outcomes
CO1 Analyze domain requirements
CO2 Adapt LLMs to specific domains
CO3 Integrate structured knowledge
CO4 Evaluate domain performance
CO5 Address ethical and regulatory risks

Detailed Syllabus

Unit I
Domain specific language modeling motivation; differences from general purpose LLMs; domain terminology; distribution shifts; task constraints; reliability requirements; interpretability needs; impact of domain context on language understanding.

Unit II
Data preparation for domains; curated corpora; expert annotations; weak supervision; synthetic data; privacy constraints; de identification; compliance requirements; data imbalance; domain drift considerations.

Unit III
Adaptation techniques; fine tuning; parameter efficient methods; adapters; prompt tuning; instruction tuning; continual learning; catastrophic forgetting; evaluation during adaptation; performance stability.

Unit IV
Knowledge integration; retrieval augmented generation; structured databases; ontologies; knowledge graphs; tool usage; grounding responses; factual consistency; traceability; explainability in domain specific reasoning.

Unit V
Domain evaluations; clinical NLP metrics; financial risk analysis; legal reasoning benchmarks; engineering document processing; robustness testing; bias analysis; accountability; deployment governance in high risk environments.

Text Books

1. Jurafsky, D., & Martin, J. H. (2023). *Speech and language processing* (3rd ed.). Pearson.
2. Liu, Y., et al. (2021). Pretrain prompt tune. *arXiv*.
3. Gu, Y., et al. (2021). Domain specific language model pretraining. *ACL*.
4. Lewis, P., et al. (2020). Retrieval augmented generation. *NeurIPS*.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Reference Books

1. Alsentzer, E., et al. (2019). Clinical BERT. *NAACL*.
2. Chalkidis, I., et al. (2020). Legal BERT. *ACL*.
3. Yang, Z., et al. (2019). XLNet. *NeurIPS*.
4. Beltagy, I., et al. (2019). SciBERT. *EMNLP*.
5. Lehman, E., et al. (2023). Evaluating LLMs in healthcare. *Nature Medicine*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Model Optimization, Fine-Tuning & Alignment

Course Category
Core Engineering Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Optimization strategies for large models
2. Fine tuning efficiency techniques
3. Alignment objectives and methodologies
4. Human feedback integration
5. Safety oriented optimization

Course Outcomes
CO1 Optimize large neural models
CO2 Apply efficient fine tuning
CO3 Align models with objectives
CO4 Integrate human feedback
CO5 Evaluate aligned model behavior

Detailed Syllabus

Unit I
Optimization challenges in large models; loss landscapes; learning rate scheduling; adaptive optimizers; gradient clipping; mixed precision training; memory optimization; training stability in deep transformer networks.

Unit II
Fine tuning strategies; full fine tuning; parameter efficient tuning; LoRA; prefix tuning;

adapters; computational tradeoffs; performance comparison; resource constrained adaptation scenarios.

Unit III
Instruction tuning; supervised fine tuning; dataset construction; task diversity; generalization effects; prompt robustness; evaluation after instruction alignment; transfer across tasks.

Unit IV
Alignment techniques; reinforcement learning from human feedback; reward modeling; preference datasets; policy optimization; exploration exploitation tradeoffs; alignment failure modes; scalability of human feedback.

Unit V
Safety and robustness; toxicity reduction; bias mitigation; refusal mechanisms; controllability; red teaming; monitoring aligned behavior; deployment safeguards; continuous evaluation post deployment.

Text Books

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
2. Sutton, R. S., & Barto, A. G. (2018). *Reinforcement learning* (2nd ed.). MIT Press.
3. Ouyang, L., et al. (2022). Training language models with human feedback. *NeurIPS*.
4. Hu, E. J., et al. (2022). LoRA. *ICLR*.
5. Christiano, P., et al. (2017). Deep reinforcement learning from human preferences. *NeurIPS*.

Reference Books

1. Bai, Y., et al. (2022). Constitutional AI. *arXiv*.
2. Rafailov, R., et al. (2023). Direct preference optimization. *arXiv*.
3. Ziegler, D. M., et al. (2019). Fine tuning language models. *arXiv*.
4. Amodei, D., et al. (2016). Concrete problems in AI safety. *arXiv*.
5. Askell, A., et al. (2021). Alignment challenges. *arXiv*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Responsible AI, Ethics & Governance

Course Category
Humanities & Management Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Ethical foundations of AI systems
2. Bias, fairness, and accountability analysis
3. Governance frameworks for AI deployment
4. Legal and regulatory awareness
5. Responsible innovation practices

Course Outcomes
CO1 Analyze ethical AI challenges
CO2 Identify bias and fairness risks
CO3 Apply governance frameworks
CO4 Interpret regulatory requirements
CO5 Promote responsible AI practices

Detailed Syllabus

Unit I
Ethical theories; AI ethics foundations; fairness concepts; harm prevention; transparency; accountability; human centered AI; value sensitive design; societal implications of intelligent systems.

Unit II
Bias in AI systems; data bias; algorithmic bias; representation harms; evaluation metrics for fairness; mitigation strategies; tradeoffs between accuracy and equity; auditing methodologies.

Unit III
Explainability and transparency; interpretability methods; model explanations; trust calibration; user understanding; limitations of explainability in deep models; communication of uncertainty.

Unit IV
AI governance frameworks; standards organizations; policy instruments; risk based regulation; documentation practices; model cards; datasheets; organizational governance structures.

Unit V
Legal and regulatory aspects; data protection laws; intellectual property; liability; compliance

challenges; global AI regulations; responsible deployment strategies; future directions of AI governance.

Text Books

1. Floridi, L. (2023). *Ethics of artificial intelligence*. Oxford University Press.
2. Mittelstadt, B., et al. (2016). Ethics of algorithms. *Big Data & Society*.
3. Barocas, S., Hardt, M., & Narayanan, A. (2023). *Fairness and machine learning*. MIT Press.
4. Jobin, A., Ienca, M., & Vayena, E. (2019). AI ethics guidelines. *Nature Machine Intelligence*.
5. Russell, S. (2019). *Human compatible*. Viking.

Reference Books

1. Selbst, A. D., et al. (2019). Fairness pitfalls. *ACM FAccT*.
2. Doshi-Velez, F., & Kim, B. (2017). Interpretability. *arXiv*.
3. OECD. (2019). *AI principles*. OECD.
4. European Commission. (2021). *AI act proposal*.
5. NIST. (2023). *AI risk management framework*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective (Edge AI / Knowledge Graphs / AI Security)

Course Category
Open Elective Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Exposure to emerging AI domains
2. Specialized system architectures
3. Applied learning in chosen area
4. Evaluation of niche AI applications
5. Integration with foundation models

Course Outcomes
CO1 Understand elective domain concepts
CO2 Apply specialized AI techniques
CO3 Analyze system constraints
CO4 Evaluate domain applications
CO5 Integrate with core AI models

Detailed Syllabus

Unit I
Overview of selected elective domain; motivation; application scenarios; system constraints; comparison with cloud based AI; relevance to foundation models and deployment contexts.

Unit II
Core techniques of elective domain; architectural components; data representations; learning objectives; computational considerations; domain specific challenges.

Unit III
Model design and training; adaptation of neural architectures; optimization under constraints; evaluation metrics; benchmarking practices in elective area.

Unit IV
System integration; interaction with sensors, graphs, or security pipelines; data flow; inference deployment; performance tradeoffs; reliability considerations.

Unit V
Case studies; real world deployments; ethical and security implications; scalability challenges; future research directions; industry adoption trends.

Text Books

1. Aggarwal, C. C. (2018). *Neural networks and deep learning*. Springer.
2. Hamilton, W. (2020). *Graph representation learning*. Morgan & Claypool.
3. Lane, N. D., et al. (2016). Deep learning for mobile. *IEEE*.
4. Papernot, N., et al. (2018). Security and ML. *IEEE*.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Reference Books

1. Wu, Z., et al. (2021). Graph neural networks survey. *IEEE TPAMI*.
2. Deng, L., & Yu, D. (2014). Deep learning overview. *IEEE*.
3. Shokri, R., et al. (2017). Membership inference attacks. *IEEE*.
4. Zhou, Z. H. (2021). *Machine learning*. Springer.
5. Kairouz, P., et al. (2021). Advances in federated learning. *Foundations and Trends*.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Industry Internship / Research Practicum

Course Category
Internship / Industrial Training Course

Credits / Contact Hours
3 Credits / 45 Contact Hours

Course Objectives

1. Industry or research exposure
2. Application of advanced AI knowledge
3. Problem formulation in real settings
4. Professional skill development
5. Research or industry reporting

Course Outcomes
CO1 Apply AI knowledge in practice
CO2 Analyze real world problems
CO3 Develop professional competencies
CO4 Produce technical reports
CO5 Reflect on research or industry experience

Guidelines
Industry or research organization attachment; defined problem statement; faculty and industry supervision; periodic progress review; final technical report submission; presentation and assessment.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IV

Intellectual Property Rights & Technology Commercialization

Course Category
Humanities & Management Course

Credits / Contact Hours
4 Credits / 60 Contact Hours

Course Objectives

1. Fundamentals of intellectual property systems
2. Legal frameworks governing innovation
3. Protection of AI driven inventions
4. Technology transfer and commercialization pathways
5. Strategic management of intellectual assets

Course Outcomes
CO1 Identify different forms of intellectual property
CO2 Interpret IP laws relevant to technology
CO3 Protect software and AI innovations
CO4 Analyze commercialization strategies
CO5 Manage IP portfolios effectively

Detailed Syllabus

Unit I
Intellectual property overview; patents, copyrights, trademarks, trade secrets; rationale for IP protection; international IP regimes; WIPO, TRIPS agreement; Indian IP framework; role of IP in innovation ecosystems.

Unit II
Patent law fundamentals; patentability criteria; novelty, inventive step, industrial applicability; patent specification structure; claims drafting basics; patent search and analysis; infringement and enforcement considerations.

Unit III
Copyright protection for software; licensing models; open source licenses; copyleft concepts; software compliance; ownership issues; database rights; protection of datasets and trained models.

Unit IV
Technology transfer mechanisms; university industry collaboration; licensing agreements;

startups and spin offs; valuation of intellectual property; commercialization strategies; funding and incubation support structures.

Unit V
IP management and strategy; portfolio management; competitive intelligence; IP risk assessment; dispute resolution; ethical considerations; future challenges in AI and data driven innovation.

Text Books

1. Cornish, W., Llewelyn, D., & Aplin, T. (2019). *Intellectual property* (9th ed.). Sweet & Maxwell.
2. Bansal, P. (2018). *Intellectual property law in India*. Oxford University Press.
3. WIPO. (2020). *Intellectual property handbook*. WIPO.
4. Bainbridge, D. (2018). *Intellectual property* (10th ed.). Pearson.
5. Mooney, R. (2016). *Technology commercialization*. Business Expert Press.

Reference Books

1. OECD. (2015). *Enquiries into intellectual property*. OECD.
2. Indian Patent Office. (2023). *Manual of patent office practice*.
3. Lemley, M. A. (2015). *IP and software*. Stanford Press.
4. Scotchmer, S. (2004). *Innovation and incentives*. MIT Press.
5. Siegel, D. S., et al. (2007). *Technology entrepreneurship*. Edward Elgar.

Evaluation Scheme
Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Research Thesis / Major Project Phase I

Course Category
Project Course

Credits / Contact Hours
6 Credits / 90 Contact Hours

Course Objectives

1. Identification of research problem
2. Comprehensive literature survey
3. Research methodology formulation
4. Experimental or theoretical framework design

5. Research proposal development

Course Outcomes
CO1 Formulate a viable research problem
CO2 Conduct systematic literature review
CO3 Design appropriate research methodology
CO4 Develop experimental or analytical framework
CO5 Prepare structured research proposal

Guidelines
Problem identification under faculty supervision; literature survey documentation; research objectives definition; methodology and dataset selection; preliminary experiments or theoretical modeling; periodic progress presentations.

Evaluation Scheme
Continuous Assessment (100%)

Course 3: Research Thesis / Major Project Phase II

Course Category
Project Course

Credits / Contact Hours
8 Credits / 120 Contact Hours

Course Objectives

1. Execution of approved research plan
2. Data collection and experimentation
3. Analysis and interpretation of results
4. Thesis writing and documentation
5. Preparation for evaluation and defense

Course Outcomes
CO1 Execute research methodology effectively
CO2 Generate and analyze results
CO3 Draw valid conclusions
CO4 Produce quality research thesis
CO5 Demonstrate independent research capability

Guidelines
Full scale implementation; experimental evaluation or theoretical validation; result analysis; thesis drafting as per university format; plagiarism compliance; submission readiness.

Evaluation Scheme
Continuous Assessment (100%)

Thesis Seminar & Viva-Voce

Course Category
Project Course

Credits / Contact Hours
2 Credits / 30 Contact Hours

Course Objectives

1. Oral presentation of research work
2. Defense of methodology and results
3. Technical communication skills
4. Critical evaluation readiness
5. Research contribution articulation

Course Outcomes
CO1 Present research effectively
CO2 Defend research contributions
CO3 Respond to expert queries
CO4 Demonstrate subject mastery
CO5 Exhibit professional research conduct

Guidelines
Pre submission seminar presentation; evaluation by internal and external experts; assessment of research originality, methodology, results, and presentation quality; viva voce examination.

Evaluation Scheme
Seminar Presentation (50%) + Viva-Voce Examination (50%)

BBA (Hons.) – Entrepreneurship & Start-ups

Duration: 4 Years | 8 SEMESTER s | Total Credits: 160

SEMESTER I

Business Mathematics & Statistics

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop mathematical competence for business decision contexts
2. Apply statistical measures to managerial and entrepreneurial problems
3. Interpret quantitative data for economic and business analysis
4. Build analytical skills for uncertainty and risk assessment
5. Strengthen logical reasoning for quantitative business modeling

Course Outcomes

- CO1: Apply functions, matrices, and calculus to business problems
- CO2: Use descriptive statistics for data summarization
- CO3: Apply probability concepts in business uncertainty
- CO4: Analyze correlation and regression for decision making
- CO5: Interpret statistical results for entrepreneurial planning

Detailed Syllabus

Unit I
Functions, limits, continuity; algebraic and transcendental functions; matrices, determinants, inverse matrices; systems of linear equations; business applications of matrices; input output analysis; demand supply modeling; quantitative representation of economic relationships.

Unit II
Differentiation techniques; marginal cost, marginal revenue, elasticity concepts; maxima and minima; optimization of profit and cost; partial derivatives; business decision optimization; comparative statics; mathematical modeling of market behavior.

Unit III
Descriptive statistics; data classification, frequency distribution; measures of central

tendency; dispersion measures; skewness, kurtosis; graphical representation; business data interpretation; managerial insights through statistical summaries.

Unit IV
Probability concepts; classical and empirical probability; addition and multiplication theorems; conditional probability; Bayes theorem; random variables; probability distributions; business risk analysis; decision making under uncertainty.

Unit V
Correlation analysis; simple linear regression; least squares method; interpretation of regression coefficients; forecasting techniques; trend analysis; business forecasting applications; quantitative support for entrepreneurial planning.

Text Books

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics* (12th ed.). Sultan Chand & Sons.
2. Dowling, E. T. (2018). *Mathematics for economics* (4th ed.). McGraw-Hill Education.
3. Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., & Cochran, J. J. (2020). *Statistics for business and economics* (14th ed.). Cengage Learning.
4. Mizrahi, A., & Sullivan, M. (2019). *Mathematics for business and social sciences* (2nd ed.). Wiley.
5. Levine, D. M., Stephan, D. F., Szabat, K. A., & Berenson, M. L. (2021). *Statistics for managers using Microsoft Excel* (9th ed.). Pearson.

Reference Books

1. Yamane, T. (2017). *Mathematics for economists* (2nd ed.). Prentice Hall.
2. Aczel, A. D., & Sounderpandian, J. (2018). *Complete business statistics* (9th ed.). McGraw-Hill Education.
3. Render, B., Stair, R. M., Hanna, M. E., & Hale, T. S. (2020). *Quantitative analysis for management* (13th ed.). Pearson.
4. Spiegel, M. R., Stephens, L. J., & Schiller, J. (2019). *Probability and statistics* (4th ed.). McGraw-Hill Education.
5. Berenson, M. L., Levine, D. M., & Szabat, K. A. (2021). *Basic business statistics* (14th ed.). Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Principles of Management

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand foundational management concepts and functions
2. Analyze managerial roles in organizational contexts
3. Examine planning and decision-making frameworks
4. Develop leadership and coordination perspectives
5. Relate management principles to entrepreneurial practice

Course Outcomes

- CO1: Explain management concepts and evolution
- CO2: Apply planning and organizing principles
- CO3: Analyze leadership and motivation theories
- CO4: Understand control and coordination mechanisms
- CO5: Integrate management principles in start-up contexts

Detailed Syllabus

Unit I
Nature of management; managerial roles and skills; evolution of management thought; classical, behavioral, and modern approaches; management as science and art; managerial effectiveness; organizational goal achievement; entrepreneurial relevance.

Unit II
Planning concepts; vision, mission, objectives; strategic, tactical, operational planning; decision making process; forecasting techniques; business environment analysis; entrepreneurial planning frameworks; risk consideration.

Unit III
Organizing principles; organizational structure; authority, responsibility, accountability; delegation; decentralization; departmentation; span of control; coordination mechanisms; organizational design for start-ups.

Unit IV
Leadership concepts; leadership styles; motivation theories; Maslow, Herzberg, McGregor; communication process; barriers; managerial leadership effectiveness; team building; start-up leadership challenges.

Unit V
Controlling concepts; control process; types of control; performance standards; management

by objectives; coordination techniques; contemporary management challenges; ethical considerations; governance perspectives.

Text Books

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2020). *Fundamentals of management* (11th ed.). Pearson.
2. Koontz, H., Weihrich, H., & Cannice, M. (2019). *Essentials of management* (10th ed.). McGraw-Hill Education.
3. Griffin, R. W. (2021). *Management* (13th ed.). Cengage Learning.
4. Tripathi, P. C., & Reddy, P. N. (2020). *Principles of management* (5th ed.). McGraw-Hill Education.
5. Drucker, P. F. (2018). *Management: Tasks, responsibilities, practices*. Routledge.

Reference Books

1. Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R. (2019). *Management* (13th ed.). Pearson.
2. Luthans, F. (2020). *Organizational behavior* (13th ed.). McGraw-Hill Education.
3. Daft, R. L. (2021). *Management* (14th ed.). Cengage Learning.
4. Certo, S. C., & Certo, S. T. (2020). *Modern management* (15th ed.). Pearson.
5. Weihrich, H., Cannice, M. V., & Koontz, H. (2019). *Management: A global and entrepreneurial perspective* (14th ed.). McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Financial Accounting

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand basic accounting concepts and principles
2. Record business transactions systematically
3. Prepare financial statements for enterprises
4. Interpret accounting information for decision making
5. Apply accounting knowledge to entrepreneurial ventures

Course Outcomes

- CO1: Explain accounting principles and standards
- CO2: Record transactions using double entry system
- CO3: Prepare final accounts
- CO4: Analyze financial statements
- CO5: Use accounting information for start-up decisions

Detailed Syllabus

Unit I
Accounting concepts and conventions; accounting standards; users of accounting information; accounting equation; double entry system; journal entries; ledger posting; trial balance preparation; accounting cycle overview.

Unit II
Subsidiary books; cash book types; purchase book; sales book; returns books; journal proper; posting procedures; balancing of accounts; practical bookkeeping applications.

Unit III
Final accounts of sole proprietorship; trading account; profit and loss account; balance sheet; adjustments; depreciation; provisions; accruals; financial position assessment.

Unit IV
Rectification of errors; types of errors; suspense account; bank reconciliation statement; causes of differences; preparation methods; cash management relevance.

Unit V
Introduction to financial statement analysis; ratio analysis; liquidity, profitability, solvency ratios; interpretation; limitations; accounting information for entrepreneurial evaluation.

Text Books

1. Tulsian, P. C. (2021). *Financial accounting* (6th ed.). Pearson.
2. Gupta, R. L., & Radhaswamy, M. (2020). *Advanced accountancy* (14th ed.). Sultan Chand & Sons.
3. Meigs, R. F., Williams, J. R., Haka, S. F., & Bettner, M. S. (2019). *Accounting: The basis for business decisions* (15th ed.). McGraw-Hill Education.
4. Jain, S. P., & Narang, K. L. (2020). *Financial accounting* (5th ed.). Kalyani Publishers.
5. Anthony, R. N., Hawkins, D. F., & Merchant, K. A. (2019). *Accounting: Text and cases* (14th ed.). McGraw-Hill Education.

Reference Books

1. Libby, R., Libby, P. A., & Short, D. G. (2020). *Financial accounting* (10th ed.). McGraw-Hill Education.
2. Wild, J. J., Shaw, K. W., & Chiappetta, B. (2021). *Fundamental accounting principles* (25th ed.). McGraw-Hill Education.
3. Kimmel, P. D., Weygandt, J. J., & Kieso, D. E. (2020). *Financial accounting* (9th ed.). Wiley.
4. Grewal, T. S. (2021). *Introduction to accounting*. Sultan Chand & Sons.
5. Porter, G. A., & Norton, C. L. (2019). *Financial accounting: The impact on decision makers* (9th ed.). Cengage Learning.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Microeconomics for Entrepreneurs

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand microeconomic principles for business decisions
2. Analyze consumer and producer behavior
3. Examine market structures and pricing
4. Evaluate cost and production relationships
5. Apply economic reasoning to entrepreneurial contexts

Course Outcomes

- CO1: Explain demand and supply mechanisms
- CO2: Analyze consumer behavior theories
- CO3: Understand production and cost concepts
- CO4: Compare market structures
- CO5: Apply microeconomic tools to start-ups

Detailed Syllabus

Unit I
Nature of microeconomics; scarcity and choice; demand analysis; law of demand; elasticity concepts; supply analysis; market equilibrium; applications to entrepreneurial pricing decisions.

Unit II
Consumer behavior; utility analysis; cardinal and ordinal approaches; indifference curves; budget constraints; consumer equilibrium; demand forecasting for new ventures.

Unit III
Production analysis; production function; law of variable proportions; returns to scale; cost concepts; short run and long run costs; entrepreneurial cost planning.

Unit IV
Market structures; perfect competition; monopoly; monopolistic competition; oligopoly; price output determination; competitive strategies for start-ups.

Unit V
Pricing practices; price discrimination; factor markets; wage determination; rent, interest, profit; microeconomic policy implications for entrepreneurs.

Text Books

1. Mankiw, N. G. (2021). *Principles of microeconomics* (9th ed.). Cengage Learning.
2. Pindyck, R. S., & Rubinfeld, D. L. (2019). *Microeconomics* (9th ed.). Pearson.
3. Salvatore, D. (2020). *Microeconomics: Theory and applications* (8th ed.). Oxford University Press.
4. Koutsoyiannis, A. (2019). *Modern microeconomics* (2nd ed.). Macmillan.
5. Dwivedi, D. N. (2020). *Microeconomics: Theory and applications*. Pearson.

Reference Books

1. Varian, H. R. (2019). *Intermediate microeconomics* (9th ed.). W. W. Norton.
2. Lipsey, R. G., & Chrystal, K. A. (2018). *Economics* (13th ed.). Oxford University Press.
3. Nicholson, W., & Snyder, C. (2020). *Microeconomic theory* (12th ed.). Cengage Learning.
4. Frank, R. H., Bernanke, B. S., & Antonovics, K. (2021). *Principles of economics* (9th ed.). McGraw-Hill Education.
5. Besanko, D., & Braeutigam, R. (2020). *Microeconomics* (6th ed.). Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Business Communication & Professional Skills

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop effective business communication skills
2. Enhance professional writing and presentation abilities
3. Improve interpersonal and team communication
4. Build employability and workplace readiness
5. Strengthen communication for entrepreneurial leadership

Course Outcomes

- CO1: Communicate effectively in business contexts
- CO2: Prepare professional documents
- CO3: Demonstrate presentation skills
- CO4: Apply interpersonal communication techniques
- CO5: Exhibit professional etiquette and ethics

Detailed Syllabus

Unit I
Communication process; barriers to communication; business communication principles; verbal and nonverbal communication; listening skills; cross cultural communication; professional effectiveness.

Unit II
Business writing; letters; emails; reports; proposals; clarity and tone; formatting standards; documentation practices; entrepreneurial correspondence.

Unit III
Oral communication; presentations; public speaking; group discussions; meetings; negotiation basics; persuasive communication skills.

Unit IV
Interpersonal skills; emotional intelligence; teamwork; leadership communication; conflict management; networking skills; professional relationships.

Unit V
Professional ethics; workplace etiquette; resume writing; interview skills; career planning; communication in start-up environments.

Text Books

1. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2020). *Business communication: Making connections in a digital world* (14th ed.). McGraw-Hill Education.
2. Bovee, C. L., & Thill, J. V. (2021). *Business communication today* (15th ed.). Pearson.
3. Chaney, L. H., & Martin, J. S. (2019). *Intercultural business communication* (6th ed.). Pearson.
4. Raman, M., & Sharma, S. (2020). *Technical communication: Principles and practice* (3rd ed.). Oxford University Press.
5. Guffey, M. E., & Loewy, D. (2021). *Essentials of business communication* (11th ed.). Cengage Learning.

Reference Books

1. Adler, R. B., Rodman, G., & du Pré, A. (2020). *Understanding human communication* (14th ed.). Oxford University Press.
2. Lucas, S. E. (2019). *The art of public speaking* (13th ed.). McGraw-Hill Education.
3. Barrett, D. J. (2018). *Leadership communication* (4th ed.). McGraw-Hill Education.
4. McLean, S. (2019). *Business communication for success*. Flat World Knowledge.
5. Pease, A., & Pease, B. (2017). *The definitive book of body language*. Bantam.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Literacy & Productivity Tools

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop basic digital literacy skills
2. Apply productivity tools for academic and business use
3. Use digital platforms for collaboration
4. Understand data security and ethics
5. Support digital readiness for entrepreneurship

Course Outcomes

- CO1: Use digital tools effectively
- CO2: Create professional documents and spreadsheets

- CO3: Apply presentation and collaboration tools
- CO4: Understand cyber safety principles
- CO5: Use digital platforms for start-up activities

List of Experiments / Exercises

1. Creation of professional documents using word processing software, including formatting standards, templates, and document sharing techniques.
2. Spreadsheet applications for basic data analysis, formulas, charts, and financial computations relevant to business scenarios.
3. Presentation development using digital tools, slide design principles, visual aids, and delivery techniques.
4. Use of email platforms for professional communication, etiquette practices, and file management.
5. Cloud storage utilization for document collaboration, version control, and data access management.
6. Online collaboration tools for virtual meetings, scheduling, and teamwork coordination.
7. Introduction to basic data visualization tools for business reporting.
8. Internet research techniques, information validation, and digital content evaluation.
9. Cyber security awareness practices, password management, and data protection measures.
10. Digital productivity tools for time management, task tracking, and workflow optimization.

Expected Outcomes

Digital competence; productivity enhancement; collaborative skills; cyber awareness; entrepreneurial digital readiness.

Evaluation Scheme

Continuous Assessment (60%) + Practical Evaluation (40%)

Field Immersion / Industry Orientation

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to real business environments
2. Understand industry operations and practices
3. Relate theoretical knowledge to practice
4. Develop observational and reporting skills
5. Build industry awareness for entrepreneurship

Course Outcomes

- CO1: Observe organizational functioning
- CO2: Identify business processes
- CO3: Relate classroom concepts to practice
- CO4: Develop professional behavior
- CO5: Prepare field immersion reports

Guidelines

Industry visits; interaction with entrepreneurs; observation of operations; documentation of learning; reflective reporting; faculty supervision.

Evaluation Scheme

Field Report (60%) + Faculty Evaluation (40%)

SEMESTER II

Business Economics

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand macroeconomic foundations relevant to business
2. Analyze economic systems and national income concepts
3. Examine money, banking, and inflation dynamics
4. Interpret fiscal and monetary policy impacts on enterprises
5. Relate economic environment to entrepreneurial decision making

Course Outcomes

- CO1: Explain basic macroeconomic concepts and aggregates
- CO2: Analyze national income and economic indicators
- CO3: Understand inflation, unemployment, and business cycles
- CO4: Evaluate monetary and fiscal policy effects
- CO5: Apply economic analysis to business environments

Detailed Syllabus

Unit I
Nature and scope of business economics; micro and macro perspectives; economic systems; circular flow of income; basic macroeconomic variables; relevance of economics to managerial decision making; entrepreneurial economic environment.

Unit II
National income concepts; GDP, GNP, NDP, NNP; methods of national income estimation; difficulties in measurement; economic growth and development; indicators of economic performance; business relevance.

Unit III
Money concepts; functions of money; demand and supply of money; banking system; role of central bank; credit creation; monetary transmission; implications for business financing.

Unit IV
Inflation concepts; demand pull and cost push inflation; effects of inflation on business; unemployment types; business cycles phases; economic stability challenges for enterprises.

Unit V
Fiscal policy; public revenue and expenditure; budget deficits; monetary policy tools; policy objectives; impact on investment, consumption, entrepreneurship, and business planning.

Text Books

1. Mankiw, N. G. (2021). *Principles of economics* (9th ed.). Cengage Learning.
2. Samuelson, P. A., & Nordhaus, W. D. (2020). *Economics* (20th ed.). McGraw-Hill Education.
3. Dwivedi, D. N. (2021). *Macroeconomics: Theory and policy*. McGraw-Hill Education.
4. Lipsey, R. G., & Chrystal, K. A. (2019). *Economics* (13th ed.). Oxford University Press.
5. Ahuja, H. L. (2020). *Macroeconomic theory and policy*. S. Chand.

Reference Books

1. Dornbusch, R., Fischer, S., & Startz, R. (2018). *Macroeconomics* (13th ed.). McGraw-Hill Education.
2. Blanchard, O. (2021). *Macroeconomics* (8th ed.). Pearson.
3. Case, K. E., Fair, R. C., & Oster, S. M. (2020). *Principles of economics* (13th ed.). Pearson.
4. Jhingan, M. L. (2019). *Macroeconomic theory*. Vrinda Publications.
5. Froyen, R. T. (2018). *Macroeconomics: Theories and policies* (11th ed.). Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Organizational Behaviour

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand individual behavior in organizations
2. Analyze group dynamics and team behavior
3. Examine motivation and leadership concepts
4. Study organizational culture and change
5. Apply behavioral insights to entrepreneurial settings

Course Outcomes

- CO1: Explain individual and group behavior concepts
- CO2: Analyze motivation and leadership theories
- CO3: Understand communication and conflict management
- CO4: Examine organizational culture and change
- CO5: Apply OB concepts in start-up organizations

Detailed Syllabus

Unit I
Nature of organizational behaviour; individual behaviour foundations; personality traits; perception processes; attitudes and values; learning concepts; implications for managerial effectiveness.

Unit II
Motivation concepts; content and process theories; Maslow, Herzberg, McClelland; expectancy theory; equity theory; motivation strategies; entrepreneurial workforce motivation.

Unit III
Group behaviour; group formation; team dynamics; leadership concepts; leadership styles; power and influence; communication processes; effectiveness in organizations.

Unit IV
Organizational culture; organizational climate; stress management; conflict types; conflict resolution strategies; negotiation basics; organizational harmony.

Unit V
Organizational change; resistance to change; change management models; organizational development; contemporary OB issues; start-up organizational challenges.

Text Books

1. Robbins, S. P., & Judge, T. A. (2020). *Organizational behavior* (18th ed.). Pearson.
2. Luthans, F. (2020). *Organizational behavior* (13th ed.). McGraw-Hill Education.
3. McShane, S. L., & Von Glinow, M. A. (2021). *Organizational behavior* (9th ed.). McGraw-Hill Education.
4. Nelson, D. L., & Quick, J. C. (2019). *Organizational behavior* (9th ed.). Cengage Learning.
5. Greenberg, J. (2020). *Behavior in organizations* (11th ed.). Pearson.

Reference Books

1. Griffin, R. W., & Moorhead, G. (2020). *Organizational behavior* (13th ed.). Cengage Learning.
2. Kreitner, R., & Kinicki, A. (2019). *Organizational behavior* (12th ed.). McGraw-Hill Education.
3. Hellriegel, D., & Slocum, J. W. (2019). *Organizational behavior* (14th ed.). Cengage Learning.
4. Champoux, J. E. (2020). *Organizational behavior*. Routledge.
5. Ivancevich, J. M., Konopaske, R., & Matteson, M. T. (2020). *Organizational behavior and management* (11th ed.). McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Cost & Management Accounting

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand cost concepts and classifications
2. Apply costing techniques for decision making
3. Analyze cost behaviour and break-even analysis
4. Use budgets and standard costing tools
5. Support managerial control and planning

Course Outcomes

- CO1: Explain cost concepts and elements
- CO2: Apply costing methods
- CO3: Analyze cost-volume-profit relationships
- CO4: Prepare budgets and standards
- CO5: Use accounting data for managerial decisions

Detailed Syllabus

Unit I
Nature and scope of cost accounting; cost concepts; cost classification; elements of cost; cost behaviour patterns; installation of costing systems; relevance to managerial planning.

Unit II
Methods of costing; job costing; batch costing; process costing; service costing; cost unit determination; applications in manufacturing and service enterprises.

Unit III
Marginal costing; contribution analysis; cost volume profit analysis; break even analysis; margin of safety; decision making applications; entrepreneurial pricing decisions.

Unit IV
Budgetary control; types of budgets; preparation of budgets; cash budget; flexible budgets; budgetary control systems; managerial control relevance.

Unit V
Standard costing; variance analysis; material, labour, overhead variances; interpretation; responsibility accounting; performance evaluation.

Text Books

1. Horngren, C. T., Datar, S. M., & Rajan, M. (2020). *Cost accounting* (16th ed.). Pearson.
2. Jain, S. P., & Narang, K. L. (2021). *Cost accounting* (7th ed.). Kalyani Publishers.
3. Drury, C. (2019). *Management and cost accounting* (10th ed.). Cengage Learning.
4. Arora, M. N. (2020). *Cost accounting*. Vikas Publishing.
5. Kaplan, R. S., & Atkinson, A. A. (2019). *Advanced management accounting* (3rd ed.). Pearson.

Reference Books

1. Bhattacharyya, A. K. (2020). *Cost accounting for business managers*. Pearson.
2. Maheshwari, S. N., & Mittal, S. N. (2019). *Cost accounting*. Vikas Publishing.
3. Blocher, E. J., Stout, D. E., Juras, P. E., & Cokins, G. (2020). *Cost management* (9th ed.). McGraw-Hill Education.
4. Garrison, R. H., Noreen, E. W., & Brewer, P. C. (2021). *Managerial accounting* (17th ed.). McGraw-Hill Education.
5. Seal, W., Garrison, R., & Noreen, E. (2019). *Management accounting*. McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Marketing Management

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand marketing concepts and processes
2. Analyze consumer understanding and segmentation
3. Examine marketing mix decisions
4. Understand branding and pricing strategies
5. Apply marketing concepts to entrepreneurial ventures

Course Outcomes

- CO1: Explain marketing principles and environment
- CO2: Analyze consumer behaviour and segmentation
- CO3: Design marketing mix strategies
- CO4: Understand branding and pricing
- CO5: Apply marketing strategies in start-ups

Detailed Syllabus

Unit I
Marketing concepts; marketing environment; consumer needs; value creation; market orientation; role of marketing in business growth; entrepreneurial marketing perspective.

Unit II
Consumer behaviour; buying decision process; market segmentation; targeting; positioning strategies; market research basics; customer analysis.

Unit III
Product decisions; product life cycle; branding strategies; packaging; product differentiation; innovation considerations for start-ups.

Unit IV
Pricing strategies; cost based, value based pricing; promotion mix; advertising; sales promotion; digital marketing basics; communication effectiveness.

Unit V
Distribution channels; logistics management; retailing concepts; marketing control; contemporary marketing challenges; sustainable marketing practices.

Text Books

1. Kotler, P., & Keller, K. L. (2021). *Marketing management* (16th ed.). Pearson.

2. Armstrong, G., & Kotler, P. (2020). *Principles of marketing* (18th ed.). Pearson.
3. Lamb, C. W., Hair, J. F., & McDaniel, C. (2020). *Marketing* (13th ed.). Cengage Learning.
4. Pride, W. M., & Ferrell, O. C. (2021). *Marketing* (20th ed.). Cengage Learning.
5. Baker, M. J., & Hart, S. (2018). *The marketing book* (7th ed.). Routledge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Introduction to Entrepreneurship & Start-ups

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand entrepreneurship concepts and evolution
2. Examine entrepreneurial mindset and traits
3. Analyze start-up ecosystems and processes
4. Study opportunity identification and feasibility
5. Promote entrepreneurial thinking and career orientation

Course Outcomes

- CO1: Explain entrepreneurship concepts and types
- CO2: Analyze entrepreneurial traits and skills
- CO3: Understand start-up life cycle
- CO4: Evaluate opportunities and feasibility
- CO5: Develop entrepreneurial orientation

Detailed Syllabus

Unit I
Entrepreneurship concepts; evolution of entrepreneurship; role in economic development; types of entrepreneurs; entrepreneurial culture; start-up orientation; innovation driven enterprises.

Unit II
Entrepreneurial mindset; creativity and innovation; opportunity recognition; idea generation techniques; feasibility analysis; market opportunity assessment.

Unit III
Start-up ecosystem; incubators; accelerators; angel investors; venture capital overview; government support schemes; institutional framework.

Unit IV
Business models; value proposition; revenue models; customer segments; cost structure; lean start-up concepts; validation approaches.

Unit V
Challenges in start-ups; risk and uncertainty; failure analysis; ethical considerations; social entrepreneurship; future of entrepreneurship.

Text Books

1. Kuratko, D. F. (2020). *Entrepreneurship: Theory, process, practice* (10th ed.). Cengage Learning.
2. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2020). *Entrepreneurship* (10th ed.). McGraw-Hill Education.
3. Barringer, B. R., & Ireland, R. D. (2019). *Entrepreneurship: Successfully launching new ventures* (6th ed.). Pearson.
4. Drucker, P. F. (2019). *Innovation and entrepreneurship*. Routledge.
5. Scarborough, N. M., & Cornwall, J. R. (2019). *Essentials of entrepreneurship and small business management* (9th ed.). Pearson.

Reference Books

1. Timmons, J. A., & Spinelli, S. (2018). *New venture creation*. McGraw-Hill Education.
2. Ries, E. (2017). *The lean startup*. Crown Business.
3. Shane, S. (2018). *The illusions of entrepreneurship*. Yale University Press.
4. Blank, S., & Dorf, B. (2020). *The startup owner's manual*. Wiley.
5. Neck, H. M., Greene, P. G., & Brush, C. G. (2018). *Teaching entrepreneurship*. Edward Elgar.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Design Thinking & Innovation

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand design thinking principles
2. Apply user centric problem solving approaches
3. Develop creative ideation skills
4. Prototype innovative solutions
5. Foster innovation driven entrepreneurial mindset

Course Outcomes

- CO1: Explain design thinking framework
- CO2: Apply empathy based problem identification
- CO3: Generate creative ideas and solutions
- CO4: Develop prototypes and test concepts
- CO5: Integrate innovation in business models

Detailed Syllabus

Unit I
Design thinking concepts; innovation fundamentals; human centered design; problem framing; creative confidence; relevance to entrepreneurship and start-up innovation.

Unit II
Empathy and user research; observation techniques; persona development; customer journey mapping; problem definition; insight generation.

Unit III
Ideation techniques; brainstorming; mind mapping; SCAMPER; creative tools; idea selection; feasibility and desirability analysis.

Unit IV
Prototyping concepts; low fidelity and high fidelity prototypes; rapid prototyping; iteration cycles; user feedback integration.

Unit V
Testing and validation; minimum viable product; innovation metrics; scaling innovations; organizational innovation culture; innovation challenges.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.

2. Liedtka, J., Ogilvie, T., & Brozenske, R. (2019). *Design thinking for the greater good*. Columbia University Press.
3. Kelley, T., & Kelley, D. (2018). *Creative confidence*. Crown Business.
4. Plattner, H., Meinel, C., & Leifer, L. (2020). *Design thinking research*. Springer.
5. Martin, R. L. (2019). *The design of business*. Harvard Business Review Press.

Reference Books

1. Lewrick, M., Link, P., & Leifer, L. (2020). *The design thinking playbook*. Wiley.
2. Osterwalder, A., & Pigneur, Y. (2020). *Business model generation*. Wiley.
3. Verganti, R. (2018). *Design driven innovation*. Harvard Business Review Press.
4. Norman, D. A. (2018). *The design of everyday things*. Basic Books.
5. IDEO. (2019). *The field guide to human centered design*. IDEO.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship / Start-up Exposure

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to start-up environments
2. Understand practical business operations
3. Relate theory to entrepreneurial practice
4. Develop professional and reporting skills
5. Enhance entrepreneurial awareness

Course Outcomes

- CO1: Observe start-up operations
- CO2: Identify entrepreneurial processes
- CO3: Relate academic learning to practice
- CO4: Develop workplace professionalism
- CO5: Prepare internship reports

Guidelines

Start-up attachment; task participation; observation logs; mentor interaction; structured reporting; faculty review.

Evaluation Scheme

Internship Report (60%) + Faculty Evaluation (40%)

SEMESTER III

Entrepreneurial Finance & Funding Strategies

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand financial requirements of entrepreneurial ventures
2. Analyze sources and stages of venture financing
3. Evaluate financial feasibility of start-ups
4. Understand valuation and funding negotiations
5. Apply financial strategies for venture growth

Course Outcomes

- CO1: Identify financial needs across venture life cycle
- CO2: Compare equity, debt, and hybrid funding sources
- CO3: Prepare basic financial projections
- CO4: Understand valuation approaches
- CO5: Apply funding strategies for entrepreneurial growth

Detailed Syllabus

Unit I
Entrepreneurial finance overview; venture life cycle stages; financial planning for start-ups; capital requirements estimation; bootstrapping concepts; financial risks; cash flow relevance; entrepreneurial financial decision context.

Unit II
Sources of finance; internal funding; external funding; debt financing; equity financing; angel investors; venture capital basics; comparative analysis; suitability across venture stages.

Unit III
Financial statements for start-ups; income statement; balance sheet; cash flow statement; financial projections; break even estimation; working capital management; financial discipline.

Unit IV
Valuation concepts; pre money and post money valuation; valuation methods; discounted cash flow; comparables approach; negotiation considerations; dilution implications.

Unit V

Funding strategies; term sheets; investor expectations; financial governance; exit options; mergers acquisitions; initial public offerings overview; sustainable financial growth planning.

Text Books

1. Leach, J. C., & Melicher, R. W. (2020). *Entrepreneurial finance* (6th ed.). Cengage Learning.
2. Berk, J., & DeMarzo, P. (2020). *Corporate finance* (5th ed.). Pearson.
3. Damodaran, A. (2019). *Applied corporate finance* (4th ed.). Wiley.
4. Bhide, A. (2018). *The origin and evolution of new businesses*. Oxford University Press.
5. Timmons, J. A., & Spinelli, S. (2018). *New venture creation*. McGraw-Hill Education.

Reference Books

1. Fabozzi, F. J., & Drake, P. P. (2019). *Finance: Capital markets, financial management*. Wiley.
2. Sahlman, W. A. (2018). *How to write a great business plan*. Harvard Business Review.
3. Brealey, R. A., Myers, S. C., & Allen, F. (2020). *Principles of corporate finance* (13th ed.). McGraw-Hill Education.
4. Kaplan, S. N., & Strömberg, P. (2019). *Venture capital*. Foundations and Trends.
5. Megginson, W. L. (2020). *Corporate finance theory*. Addison-Wesley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

New Venture Creation & Business Planning

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand venture creation processes
2. Develop structured business plans
3. Analyze feasibility and market validation
4. Integrate functional planning for start-ups
5. Build implementation and execution perspectives

Course Outcomes

- CO1: Explain venture creation stages
- CO2: Identify and evaluate business opportunities
- CO3: Prepare comprehensive business plans
- CO4: Integrate marketing, operations, and finance plans
- CO5: Assess venture feasibility and scalability

Detailed Syllabus

Unit I
New venture creation process; opportunity identification; environmental scanning; idea screening; feasibility dimensions; industry analysis; competitive landscape; entrepreneurial readiness assessment.

Unit II
Market analysis; customer identification; value proposition design; demand estimation; competitive positioning; validation techniques; primary and secondary data relevance.

Unit III
Business model development; revenue models; cost structures; resource requirements; operational planning; technology considerations; organizational structure basics.

Unit IV
Financial planning; capital budgeting basics; projected financial statements; funding requirements; break even planning; risk assessment; sensitivity analysis.

Unit V
Business plan presentation; implementation roadmap; milestones; performance metrics; growth strategies; scaling considerations; exit planning overview.

Text Books

1. Barringer, B. R., & Ireland, R. D. (2019). *Entrepreneurship* (6th ed.). Pearson.
2. Kuratko, D. F. (2020). *Entrepreneurship* (10th ed.). Cengage Learning.
3. Scarborough, N. M., & Cornwall, J. R. (2019). *Essentials of entrepreneurship*. Pearson.
4. Burns, P. (2020). *New venture creation*. Palgrave Macmillan.
5. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2020). *Entrepreneurship*. McGraw-Hill Education.

Reference Books

1. Timmons, J. A., & Spinelli, S. (2018). *New venture creation*. McGraw-Hill Education.

2. Osterwalder, A., & Pigneur, Y. (2020). *Business model generation*. Wiley.
3. Blank, S., & Dorf, B. (2020). *The startup owner's manual*. Wiley.
4. Mullins, J. (2019). *The new business road test*. Pearson.
5. Abrams, R. (2020). *Successful business plan*. Planning Shop.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Operations & Supply Chain Management

Course Category: Management & Functional Areas
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand operations management fundamentals
2. Analyze supply chain structures and flows
3. Apply process design and capacity concepts
4. Understand inventory and logistics management
5. Support operational efficiency in ventures

Course Outcomes

- CO1: Explain operations and supply chain concepts
- CO2: Analyze process and capacity decisions
- CO3: Apply inventory management techniques
- CO4: Understand logistics and distribution systems
- CO5: Improve operational performance

Detailed Syllabus

Unit I
Operations management overview; transformation processes; operations strategy; productivity concepts; competitiveness; relevance to manufacturing and service ventures.

Unit II
Process design; process mapping; capacity planning; facility location; layout planning; technology selection; operational flexibility considerations.

Unit III
Supply chain concepts; supply chain drivers; sourcing strategies; supplier selection; coordination mechanisms; risk management in supply chains.

Unit IV
Inventory management; EOQ model; reorder levels; safety stock; just in time concepts; inventory control systems; cost trade offs.

Unit V
Logistics management; transportation modes; warehousing; distribution management; performance measurement; sustainable operations practices.

Text Books

1. Heizer, J., Render, B., & Munson, C. (2020). *Operations management* (13th ed.). Pearson.
2. Chopra, S., & Meindl, P. (2020). *Supply chain management* (7th ed.). Pearson.
3. Slack, N., Brandon-Jones, A., & Johnston, R. (2021). *Operations management* (9th ed.). Pearson.
4. Krajewski, L. J., Malhotra, M. K., & Ritzman, L. P. (2019). *Operations management*. Pearson.
5. Ballou, R. H. (2018). *Business logistics management*. Pearson.

Reference Books

1. Stevenson, W. J. (2020). *Operations management* (14th ed.). McGraw-Hill Education.
2. Christopher, M. (2019). *Logistics and supply chain management*. Pearson.
3. Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2020). *Purchasing and supply chain management*. Cengage Learning.
4. Jacobs, F. R., & Chase, R. B. (2021). *Operations and supply chain management*. McGraw-Hill Education.
5. Waters, D. (2019). *Supply chain management*. Palgrave.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Legal Aspects of Business & Company Law

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand legal framework governing business
2. Analyze contract and commercial laws
3. Understand company formation and governance
4. Examine regulatory compliance requirements
5. Apply legal knowledge to entrepreneurial activities

Course Outcomes

- CO1: Explain basic business laws
- CO2: Understand contract and agency laws
- CO3: Analyze company law provisions
- CO4: Understand corporate governance principles
- CO5: Apply legal compliance in ventures

Detailed Syllabus

Unit I
Nature of business law; sources of law; Indian legal system overview; law of contracts basics; essential elements; contractual capacity; legality of objects.

Unit II
Performance and discharge of contracts; breach and remedies; special contracts; indemnity; guarantee; bailment; agency concepts; business relevance.

Unit III
Company law overview; types of companies; incorporation procedures; memorandum and articles; share capital; membership concepts.

Unit IV
Company management; directors; meetings; corporate governance principles; statutory compliances; regulatory authorities; stakeholder protection.

Unit V
Winding up concepts; insolvency basics; consumer protection overview; competition law basics; legal compliance for start-ups.

Text Books

1. Kapoor, N. D. (2020). *Elements of mercantile law*. Sultan Chand & Sons.

2. Kuchhal, M. C., & Kuchhal, V. (2019). *Business law*. Vikas Publishing.
3. Singh, A. K. (2020). *Company law*. Eastern Book Company.
4. Avtar Singh. (2019). *Company law*. Eastern Book Company.
5. Tulsian, P. C. (2021). *Business law*. McGraw-Hill Education.

Reference Books

1. Pathak, A. (2019). *Legal aspects of business*. McGraw-Hill Education.
2. Majumdar, A. K., & Kapoor, G. K. (2020). *Company law and practice*. Taxmann.
3. Gulshan, S. S. (2019). *Business law*. Excel Books.
4. Sharma, J. P. (2020). *Company law*. Ane Books.
5. Jain, N. (2021). *Business laws*. Taxmann.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Technology Management & Digital Transformation

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand role of technology in business
2. Analyze digital transformation drivers
3. Examine technology adoption strategies
4. Understand innovation and competitiveness
5. Apply technology management in start-ups

Course Outcomes

- CO1: Explain technology management concepts
- CO2: Analyze digital transformation initiatives
- CO3: Understand technology strategy alignment
- CO4: Evaluate emerging digital technologies
- CO5: Apply digital tools for venture growth

Detailed Syllabus

Unit I
Technology management overview; technology as competitive resource; technology life cycle; innovation dynamics; relevance to entrepreneurial competitiveness.

Unit II
Digital transformation concepts; digitization; digitalization; platforms; data driven business models; organizational readiness considerations.

Unit III
Emerging technologies; artificial intelligence; cloud computing; blockchain basics; internet of things; application contexts for start-ups.

Unit IV
Technology adoption; change management; cybersecurity awareness; digital ethics; regulatory concerns; risk mitigation strategies.

Unit V
Technology strategy; integration with business strategy; scaling digital solutions; technology partnerships; future digital trends.

Text Books

1. Burgelman, R. A., Christensen, C. M., & Wheelwright, S. C. (2018). *Strategic management of technology and innovation*. McGraw-Hill Education.
2. Westerman, G., Bonnet, D., & McAfee, A. (2019). *Leading digital*. Harvard Business Review Press.
3. Schilling, M. A. (2020). *Strategic management of technological innovation*. McGraw-Hill Education.
4. Kane, G. C. (2019). *The technology fallacy*. MIT Press.
5. Rogers, D. L. (2019). *The digital transformation playbook*. Columbia University Press.

Reference Books

1. Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2019). *Digital business strategy*. MIS Quarterly.
2. Laudon, K. C., & Laudon, J. P. (2020). *Management information systems*. Pearson.
3. Vial, G. (2019). *Understanding digital transformation*. MIS Quarterly.
4. Tapscott, D. (2018). *Blockchain revolution*. Penguin.
5. Brynjolfsson, E., & McAfee, A. (2017). *The second machine age*. Norton.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Humanities Elective (Ethics / Indian Knowledge Systems)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand ethical foundations and values
2. Examine ethical issues in business
3. Appreciate Indian knowledge traditions
4. Apply ethical reasoning to decisions
5. Promote responsible entrepreneurship

Course Outcomes

- CO1: Explain ethical theories and values
- CO2: Identify ethical issues in business
- CO3: Understand Indian knowledge perspectives
- CO4: Apply ethical reasoning frameworks
- CO5: Promote ethical entrepreneurial conduct

Detailed Syllabus

Unit I
Ethics concepts; values; morality; ethical theories; utilitarianism; deontology; virtue ethics; relevance to business conduct.

Unit II
Business ethics; ethical issues in management; corporate responsibility; governance ethics; stakeholder perspectives.

Unit III
Indian knowledge systems; philosophical foundations; indigenous knowledge traditions; ethical teachings; societal relevance.

Unit IV
Ethics in entrepreneurship; ethical dilemmas; decision making frameworks; sustainability orientation; inclusive growth.

Unit V
Professional ethics; codes of conduct; social responsibility; ethical leadership; nation building perspectives.

Text Books

1. Velasquez, M. G. (2020). *Business ethics*. Pearson.

2. Sharma, R. (2019). *Indian knowledge systems*. PHI Learning.
3. Crane, A., & Matten, D. (2021). *Business ethics*. Oxford University Press.
4. Radhakrishnan, S. (2018). *Indian philosophy*. Oxford University Press.
5. Chakraborty, S. K. (2019). *Ethics in management*. Oxford University Press.

Reference Books

1. Sen, A. (2018). *The idea of justice*. Harvard University Press.
2. Gandhi, M. K. (2018). *Hind Swaraj*. Navajivan Publishing.
3. Freeman, R. E. (2019). *Strategic management: A stakeholder approach*. Cambridge University Press.
4. Narayanan, S. (2020). *Indian ethos and values*. Himalaya Publishing.
5. Bhattacharyya, S. (2019). *Ethics and governance*. Oxford University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide practical exposure to organizations
2. Understand operational and managerial practices
3. Relate academic learning to practice
4. Develop professional competencies
5. Build industry readiness

Course Outcomes

- CO1: Observe organizational processes
- CO2: Apply classroom knowledge
- CO3: Develop professional discipline
- CO4: Enhance analytical observation skills
- CO5: Prepare structured internship reports

Guidelines

Industry attachment; defined tasks; observation records; mentor interaction; report preparation; faculty evaluation.

Evaluation Scheme

Internship Report (60%) + Faculty Evaluation (40%)

SEMESTER IV

Innovation Management & Product Development

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand innovation concepts and management processes
2. Analyze product development life cycle stages
3. Examine innovation strategies for competitive advantage
4. Integrate technology, market, and design perspectives
5. Apply innovation management in entrepreneurial contexts

Course Outcomes

- CO1: Explain innovation types and processes
- CO2: Analyze product development stages
- CO3: Evaluate innovation strategies
- CO4: Integrate market and technology inputs
- CO5: Apply innovation frameworks in start-ups

Detailed Syllabus

Unit I
Innovation concepts and definitions; incremental and radical innovation; product and process innovation; sources of innovation; innovation ecosystems; role of innovation in entrepreneurship; competitive advantage perspectives.

Unit II
Product development process; idea generation; concept screening; feasibility analysis; customer requirements; design specifications; cross functional coordination; development planning.

Unit III
New product development models; stage gate process; agile development approaches; design for manufacturability; quality considerations; time to market factors.

Unit IV
Technology and innovation strategy; technology road mapping; collaboration and open innovation; intellectual property considerations; innovation risk management.

Unit V
Product launch strategies; commercialization planning; diffusion of innovation; adoption curves; product life cycle management; continuous improvement approaches.

Text Books

1. Trott, P. (2020). *Innovation management and new product development* (7th ed.). Pearson.
2. Crawford, C. M., & Di Benedetto, C. A. (2019). *New products management* (11th ed.). McGraw-Hill Education.
3. Schilling, M. A. (2020). *Strategic management of technological innovation*. McGraw-Hill Education.
4. Cooper, R. G. (2019). *Winning at new products* (5th ed.). Basic Books.
5. Tidd, J., & Bessant, J. (2021). *Managing innovation* (7th ed.). Wiley.

Reference Books

1. Ulrich, K. T., & Eppinger, S. D. (2020). *Product design and development* (7th ed.). McGraw-Hill Education.
2. Wheelwright, S. C., & Clark, K. B. (2019). *Revolutionizing product development*. Free Press.
3. Verganti, R. (2018). *Design driven innovation*. Harvard Business Review Press.
4. Chesbrough, H. (2020). *Open innovation*. Harvard Business Review Press.
5. Kotler, P., & Keller, K. L. (2021). *Marketing management*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Start-up Marketing & Growth Hacking

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand marketing challenges of start-ups
2. Analyze digital and growth driven marketing approaches
3. Examine customer acquisition and retention strategies
4. Apply data driven marketing techniques
5. Support rapid scaling of start-ups

Course Outcomes

- CO1: Explain start-up marketing fundamentals
- CO2: Apply growth hacking techniques
- CO3: Analyze customer acquisition metrics
- CO4: Use digital marketing tools
- CO5: Design scalable marketing strategies

Detailed Syllabus

Unit I
Start-up marketing characteristics; differences from traditional marketing; early adopter focus; value proposition communication; lean marketing concepts; growth orientation.

Unit II
Customer acquisition strategies; funnels; conversion metrics; customer lifetime value; retention strategies; referral mechanisms; engagement models.

Unit III
Growth hacking concepts; experimentation mindset; A B testing; viral loops; traction channels; rapid iteration techniques.

Unit IV
Digital marketing tools; social media marketing; content marketing; search engine optimization basics; paid campaigns; analytics overview.

Unit V
Scaling marketing efforts; brand building for start-ups; community building; ethical considerations; sustainable growth management.

Text Books

1. Ellis, S., & Brown, M. (2017). *Hacking growth*. Crown Business.
2. Kotler, P., Kartajaya, H., & Setiawan, I. (2021). *Marketing 5.0*. Wiley.
3. Ryan, D. (2020). *Understanding digital marketing* (5th ed.). Kogan Page.
4. Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2020). *Value proposition design*. Wiley.
5. Fishkin, R. (2019). *Lost and founder*. Portfolio.

Reference Books

1. Halligan, B., & Shah, D. (2020). *Inbound marketing*. Wiley.
2. Chaffey, D., & Ellis-Chadwick, F. (2019). *Digital marketing* (7th ed.). Pearson.
3. Godin, S. (2018). *This is marketing*. Portfolio.

4. Ries, E. (2017). *The lean startup*. Crown Business.
5. Pulizzi, J. (2019). *Content marketing*. McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Business Analytics for Decision Making

Course Category: Management & Functional Areas
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand role of analytics in business decisions
2. Analyze data driven decision frameworks
3. Apply descriptive and predictive analytics
4. Interpret analytical results for management
5. Support evidence based entrepreneurial decisions

Course Outcomes

- CO1: Explain business analytics concepts
- CO2: Apply descriptive analytics tools
- CO3: Use basic predictive techniques
- CO4: Interpret data for decision making
- CO5: Apply analytics in start-up contexts

Detailed Syllabus

Unit I
Business analytics overview; data driven decision making; types of analytics; data sources; analytical thinking; relevance to entrepreneurship.

Unit II
Data preparation; data cleaning; exploratory data analysis; descriptive statistics; visualization techniques; managerial interpretation.

Unit III
Predictive analytics concepts; regression basics; forecasting techniques; trend analysis; decision support applications.

Unit IV
Prescriptive analytics overview; optimization basics; scenario analysis; decision trees; risk analysis fundamentals.

Unit V
Analytics implementation; tools overview; ethical considerations; data governance; analytics for strategic decisions.

Text Books

1. Evans, J. R. (2020). *Business analytics* (3rd ed.). Pearson.
2. Provost, F., & Fawcett, T. (2019). *Data science for business*. O'Reilly.
3. Sharda, R., Delen, D., & Turban, E. (2020). *Business intelligence, analytics, and data science*. Pearson.
4. McAfee, A., & Brynjolfsson, E. (2018). *Machine, platform, crowd*. Norton.
5. Davenport, T. H. (2019). *Competing on analytics*. Harvard Business Review Press.

Reference Books

1. Watson, H. J. (2019). *Business analytics*. Pearson.
2. Waller, M. A., & Fawcett, S. E. (2019). *Data science, predictive analytics*. Journal of Business Logistics.
3. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2020). *Multivariate data analysis*. Cengage Learning.
4. Siegel, E. (2018). *Predictive analytics*. Wiley.
5. Laursen, G. H. N., & Thorlund, J. (2019). *Business analytics for managers*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Intellectual Property Rights & Patents

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand intellectual property concepts
2. Analyze patent laws and procedures
3. Examine protection of innovations
4. Understand commercialization of IP

5. Apply IP strategies in start-ups

Course Outcomes

- CO1: Explain types of intellectual property
- CO2: Understand patent filing processes
- CO3: Analyze IP protection strategies
- CO4: Understand IP commercialization
- CO5: Apply IP management in ventures

Detailed Syllabus

Unit I
Intellectual property concepts; patents; trademarks; copyrights; industrial designs; geographical indications; importance for innovation based enterprises.

Unit II
Patent system overview; patentability criteria; novelty; inventive step; industrial applicability; patent documentation basics.

Unit III
Patent filing process; Indian patent law overview; rights and obligations; patent examination; opposition procedures.

Unit IV
IP commercialization; licensing; assignment; technology transfer; valuation basics; strategic use of IP.

Unit V
IP management in start-ups; infringement issues; enforcement mechanisms; global IP perspectives; ethical considerations.

Text Books

1. Watal, J. (2019). *Intellectual property rights in the WTO and developing countries*. Oxford University Press.
2. Narayanan, P. (2020). *Patent law*. Eastern Book Company.
3. Cornish, W., Llewelyn, D., & Aplin, T. (2019). *Intellectual property*. Sweet & Maxwell.
4. Bansal, A. (2021). *Intellectual property law*. Oxford University Press.
5. Ganguli, P. (2018). *Intellectual property rights*. Tata McGraw-Hill.

Reference Books

1. Goldstein, P. (2019). *Intellectual property*. Aspen Publishers.

2. Bainbridge, D. (2018). *Intellectual property*. Pearson.
3. Miller, A. R., & Davis, M. J. (2020). *Intellectual property: Patents, trademarks*. West Academic.
4. TRIPS Agreement. (2019). *WTO legal texts*. WTO.
5. WIPO. (2020). *Introduction to intellectual property*. WIPO.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (FinTech / Agri-Business / Social Entrepreneurship)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand sector specific entrepreneurial models
2. Analyze opportunities in chosen elective domain
3. Examine innovation and business challenges
4. Apply entrepreneurial frameworks to specific sectors
5. Promote diversified entrepreneurial exposure

Course Outcomes

- CO1: Explain domain specific concepts
- CO2: Analyze sector opportunities
- CO3: Understand business models in the sector
- CO4: Apply entrepreneurial strategies
- CO5: Evaluate sector growth potential

Detailed Syllabus

Unit I
Sector overview; scope and characteristics; market structure; value chains; opportunity landscape; regulatory environment basics.

Unit II
Business models in the sector; customer segments; revenue mechanisms; cost structures; competitive dynamics.

Unit III
Technology and innovation trends; digital interventions; productivity enhancement; scalability considerations.

Unit IV
Financial and operational challenges; risk factors; sustainability issues; social and economic impact.

Unit V
Policy support; government initiatives; future trends; career and entrepreneurial opportunities.

Text Books

1. Osterwalder, A., & Pigneur, Y. (2020). *Business model generation*. Wiley.
2. Kotler, P. (2021). *Marketing management*. Pearson.
3. Drucker, P. F. (2019). *Innovation and entrepreneurship*. Routledge.
4. World Bank. (2020). *Sector development reports*. World Bank Publications.
5. UNDP. (2019). *Entrepreneurship and innovation*. UNDP.

Reference Books

1. Schumpeter, J. A. (2018). *Capitalism, socialism and democracy*. Routledge.
2. Porter, M. E. (2019). *Competitive advantage*. Free Press.
3. Prahalad, C. K. (2019). *The fortune at the bottom of the pyramid*. Pearson.
4. Khanna, T. (2019). *Trust*. Penguin.
5. OECD. (2020). *Entrepreneurship at a glance*. OECD.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Entrepreneurship Laboratory / Incubation Practicum

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Apply entrepreneurial concepts through practice
2. Develop venture ideas in incubation settings
3. Use tools for validation and prototyping

4. Build teamwork and execution skills
5. Prepare for venture launch readiness

Course Outcomes

- CO1: Generate and validate business ideas
- CO2: Apply lean start-up tools
- CO3: Develop prototypes or pilots
- CO4: Work effectively in teams
- CO5: Present venture outcomes

List of Experiments / Exercises

1. Identification of problem statements and opportunity mapping using customer discovery interviews and observation techniques.
2. Idea generation and screening using brainstorming, SCAMPER, and feasibility matrices for venture selection.
3. Preparation of value proposition canvas focusing on customer pains, gains, and solution fit.
4. Development of business model canvas covering key partners, activities, resources, and revenue streams.
5. Market validation through surveys, interviews, and minimum viable product testing approaches.
6. Financial estimation exercises including basic cost structures and revenue projections.
7. Prototype development using low fidelity tools and rapid iteration methods.
8. Pitch deck preparation covering problem, solution, market, and traction.
9. Mentoring interaction documentation with incubator or industry experts.
10. Final venture presentation and demonstration of validated learning outcomes.
11. Team reflection and learning assessment based on execution challenges and insights.

Expected Outcomes

Idea validation; practical exposure; teamwork capability; innovation skills; venture readiness.

Evaluation Scheme

Continuous Assessment (60%) + Practical Evaluation (40%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued industry exposure
2. Strengthen applied learning experience
3. Enhance professional competence
4. Observe advanced organizational practices
5. Support career and entrepreneurial readiness

Course Outcomes

- CO1: Apply practical knowledge in organizations
- CO2: Analyze operational practices
- CO3: Demonstrate professional behavior
- CO4: Prepare analytical internship reports
- CO5: Integrate learning with career goals

Guidelines

Extended industry attachment; defined responsibilities; progress monitoring; documentation of learning; faculty assessment.

Evaluation Scheme

Internship Report (60%) + Faculty Evaluation (40%)

SEMESTER V

Venture Capital, Private Equity & Angel Investing

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand venture capital and private equity ecosystems
2. Analyze investment stages and funding structures
3. Examine investor evaluation and due diligence processes
4. Understand term sheets and deal structuring
5. Apply investment perspectives to entrepreneurial growth

Course Outcomes

- CO1: Explain VC, PE, and angel investment concepts
- CO2: Analyze funding stages and instruments
- CO3: Understand investor evaluation criteria
- CO4: Interpret term sheets and valuation logic
- CO5: Apply funding insights for venture scaling

Detailed Syllabus

Unit I
Venture capital overview; private equity concepts; angel investing fundamentals; investment ecosystem participants; role of funds; differences between VC, PE, and angels; relevance to start-up growth financing.

Unit II
Investment stages; seed, early, growth, late stage funding; deal sourcing; screening processes; investment theses; sector focus; portfolio diversification principles.

Unit III
Due diligence process; market diligence; financial diligence; legal diligence; technology assessment; risk evaluation; investment committee considerations.

Unit IV
Valuation approaches; pre money valuation; post money valuation; equity dilution; term sheets; liquidation preferences; control rights; negotiation dynamics.

Unit V
Exit strategies; mergers and acquisitions; initial public offerings; secondary sales; fund performance metrics; ethical issues; sustainable investment perspectives.

Text Books

1. Gompers, P. A., & Lerner, J. (2020). *The venture capital cycle* (3rd ed.). MIT Press.
2. Damodaran, A. (2019). *Applied corporate finance* (4th ed.). Wiley.
3. Fraser-Sampson, G. (2018). *Private equity as an asset class*. Wiley.
4. Sahlman, W. A. (2018). *Entrepreneurial finance*. Harvard Business School Press.
5. Lerner, J., Leamon, A., & Hardymon, F. (2019). *Venture capital and private equity*. Wiley.

Reference Books

1. Metrick, A., & Yasuda, A. (2020). *Venture capital and the finance of innovation* (3rd ed.). Wiley.
2. Kaplan, S. N., & Strömberg, P. (2019). *Venture capital*. Foundations and Trends.
3. Rosenbaum, J., & Pearl, J. (2020). *Investment banking*. Wiley.
4. Megginson, W. L. (2020). *Corporate finance theory*. Addison-Wesley.
5. Gilligan, J., & Wright, M. (2018). *Private equity demystified*. ICAEW.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Scaling Start-ups & Growth Management

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand growth challenges faced by start-ups
2. Analyze scaling strategies and organizational readiness
3. Examine operational and market expansion issues
4. Understand leadership and culture during growth
5. Apply growth management frameworks

Course Outcomes

- CO1: Explain growth stages of start-ups

- CO2: Analyze scaling strategies
- CO3: Understand operational scaling challenges
- CO4: Manage organizational growth and culture
- CO5: Apply sustainable growth practices

Detailed Syllabus

Unit I
Growth stages of start-ups; transition from start-up to scale-up; growth drivers; constraints; strategic choices; scalability assessment; entrepreneurial growth orientation.

Unit II
Market expansion strategies; geographic expansion; customer segment expansion; partnerships; alliances; channel scaling considerations.

Unit III
Operational scaling; process standardization; capacity expansion; technology enablement; quality control; risk management during growth.

Unit IV
Organizational scaling; leadership transitions; talent acquisition; culture preservation; systems and controls; governance needs.

Unit V
Growth measurement; key performance indicators; sustainable growth; managing hyper growth; ethical considerations; long term value creation.

Text Books

1. Moore, G. A. (2018). *Crossing the chasm*. Harper Business.
2. Isenberg, D. (2019). *Worthless, impossible and stupid*. Harvard Business Review Press.
3. Ries, E. (2017). *The lean startup*. Crown Business.
4. Osterwalder, A., & Pigneur, Y. (2020). *Business model generation*. Wiley.
5. Blank, S. (2020). *The startup owner's manual*. Wiley.

Reference Books

1. Sutton, R. I., & Rao, H. (2019). *Scaling up excellence*. Crown Business.
2. McKelvie, A., & Wiklund, J. (2018). *How knowledge affects opportunity recognition*. Entrepreneurship Theory.
3. Greiner, L. E. (2019). *Evolution and revolution as organizations grow*. Harvard Business Review.

4. Foster, R. (2018). *Innovation: The attacker's advantage*. Summit Books.
5. Christensen, C. M. (2019). *The innovator's dilemma*. Harvard Business Review Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Corporate Strategy & Competitive Advantage

Course Category: Management & Functional Areas
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand strategic management concepts
2. Analyze competitive environments and positioning
3. Examine corporate and business level strategies
4. Understand sources of competitive advantage
5. Apply strategy frameworks to enterprises

Course Outcomes

- CO1: Explain strategy concepts and processes
- CO2: Analyze industry and competitive forces
- CO3: Formulate business level strategies
- CO4: Understand corporate level strategy choices
- CO5: Apply strategic analysis tools

Detailed Syllabus

Unit I
Strategic management overview; vision and mission; strategic intent; external environment analysis; PESTLE framework; competitive landscape assessment.

Unit II
Industry analysis; Porter five forces; strategic groups; competitor analysis; entry barriers; industry attractiveness evaluation.

Unit III
Business level strategies; cost leadership; differentiation; focus strategies; value chain analysis; sustaining competitive advantage.

Unit IV
Corporate level strategies; diversification; mergers and acquisitions; strategic alliances; vertical integration; portfolio analysis.

Unit V
Strategy implementation; organizational structure; strategic control; balanced scorecard; ethical strategy considerations; strategic leadership.

Text Books

1. Porter, M. E. (2019). *Competitive strategy*. Free Press.
2. Grant, R. M. (2020). *Contemporary strategy analysis* (10th ed.). Wiley.
3. Johnson, G., Scholes, K., & Whittington, R. (2020). *Exploring strategy* (12th ed.). Pearson.
4. Hill, C. W. L., Jones, G. R., & Schilling, M. A. (2021). *Strategic management* (13th ed.). Cengage Learning.
5. Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2020). *Strategic management*. Cengage Learning.

Reference Books

1. Barney, J. B. (2019). *Gaining and sustaining competitive advantage*. Pearson.
2. Rumelt, R. P. (2018). *Good strategy bad strategy*. Crown Business.
3. Mintzberg, H. (2018). *Strategy safari*. Free Press.
4. Besanko, D., Dranove, D., Shanley, M., & Schaefer, S. (2020). *Economics of strategy*. Wiley.
5. Teece, D. J. (2019). *Dynamic capabilities and strategic management*. Oxford University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Public Policy, Start-up Ecosystems & Governance

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand role of public policy in entrepreneurship
2. Analyze start-up ecosystems and institutional support

3. Examine governance frameworks and compliance
4. Understand regulatory environment for ventures
5. Apply policy awareness to entrepreneurial decisions

Course Outcomes

- CO1: Explain public policy concepts
- CO2: Analyze start-up ecosystem components
- CO3: Understand governance and compliance
- CO4: Evaluate policy impacts on start-ups
- CO5: Apply policy insights to ventures

Detailed Syllabus

Unit I
Public policy concepts; policy making process; economic policy objectives; role of government in entrepreneurship promotion; institutional framework.

Unit II
Start-up ecosystems; incubators; accelerators; innovation hubs; university industry linkages; ecosystem stakeholders; collaboration mechanisms.

Unit III
Regulatory environment; ease of doing business; compliance requirements; taxation basics; labor regulations; policy challenges for start-ups.

Unit IV
Corporate governance concepts; transparency; accountability; board structures; governance practices in emerging enterprises.

Unit V
Indian start-up policies; national initiatives; state level policies; global comparisons; future policy directions; inclusive growth perspectives.

Text Books

1. Audretsch, D. B. (2018). *Entrepreneurship policy*. Oxford University Press.
2. OECD. (2020). *Entrepreneurship at a glance*. OECD.
3. Khanna, T. (2018). *Trust*. Penguin.
4. Sharma, S. (2019). *Public policy and governance*. Oxford University Press.
5. World Bank. (2020). *Doing business reports*. World Bank Publications.

Reference Books

1. Isenberg, D. (2019). *Entrepreneurship ecosystem strategy*. Harvard Business School.
2. Mazzucato, M. (2018). *The entrepreneurial state*. Penguin.
3. North, D. C. (2019). *Institutions, institutional change*. Cambridge University Press.
4. Acs, Z. J., & Szerb, L. (2018). *Global entrepreneurship index*. Springer.
5. UNCTAD. (2020). *Entrepreneurship policy framework*. United Nations.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Family Business / Social Impact Ventures)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand elective specific entrepreneurial models
2. Analyze governance and succession challenges
3. Examine social and economic impact dimensions
4. Apply management frameworks to elective domain
5. Promote responsible and inclusive entrepreneurship

Course Outcomes

- CO1: Explain elective domain concepts
- CO2: Analyze governance and impact issues
- CO3: Understand sustainability and succession
- CO4: Apply strategic frameworks
- CO5: Evaluate long term value creation

Detailed Syllabus

Unit I
Family business or social venture overview; characteristics; ownership structures; mission orientation; stakeholder roles; contextual relevance.

Unit II
Governance frameworks; family councils; boards; succession planning; leadership transition; continuity challenges.

Unit III
Strategy formulation; competitive positioning; resource management; professionalization; conflict management.

Unit IV
Impact measurement; social return on investment; sustainability models; financial viability; hybrid value creation.

Unit V
Policy support; institutional frameworks; future trends; global perspectives; ethical considerations.

Text Books

1. Gersick, K. E., Davis, J. A., Hampton, M. M., & Lansberg, I. (2019). *Generation to generation*. Harvard Business School Press.
2. Dees, J. G. (2018). *Social entrepreneurship*. Duke University Press.
3. Porter, M. E., & Kramer, M. R. (2019). *Creating shared value*. Harvard Business Review.
4. Bornstein, D. (2018). *How to change the world*. Oxford University Press.
5. Sharma, P. (2019). *Family business governance*. Edward Elgar.

Reference Books

1. Collins, J., & Porras, J. (2019). *Built to last*. Harper Business.
2. Yunus, M. (2018). *Building social business*. PublicAffairs.
3. Randel, A. E., et al. (2019). *Inclusive leadership*. Routledge.
4. Austin, J., Stevenson, H., & Wei-Skillern, J. (2018). *Social entrepreneurship*. Harvard Business School.
5. Ward, J. L. (2019). *Keeping the family business healthy*. Palgrave.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project (Business Plan / Start-up Prototype)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Integrate learning across functional areas

2. Develop practical business plan or prototype
3. Apply analytical and strategic tools
4. Enhance teamwork and execution capability
5. Prepare for major project and venture launch

Course Outcomes

- CO1: Identify viable business problems
- CO2: Develop structured business plans or prototypes
- CO3: Apply financial and market analysis
- CO4: Demonstrate project execution skills
- CO5: Present professional project outcomes

Guidelines

Problem identification; proposal approval; literature and market review; business plan or prototype development; periodic reviews; final report and presentation.

Evaluation Scheme

Continuous Assessment (40%) + Final Project Evaluation (60%)

SEMESTER VI

Strategic Leadership & Negotiation

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand strategic leadership concepts and roles
2. Analyze leadership styles in dynamic business environments
3. Develop negotiation perspectives and frameworks
4. Examine ethical and responsible leadership practices
5. Apply leadership skills in entrepreneurial contexts

Course Outcomes

- CO1: Explain strategic leadership concepts
- CO2: Analyze leadership styles and behaviors
- CO3: Apply negotiation strategies and tactics
- CO4: Understand ethical leadership dimensions
- CO5: Demonstrate leadership effectiveness in ventures

Detailed Syllabus

Unit I
Strategic leadership concepts; leadership versus management; leadership roles; vision formulation; strategic intent; leadership competencies; entrepreneurial leadership orientation.

Unit II
Leadership theories; trait, behavioral, contingency approaches; transformational leadership; situational leadership; leadership effectiveness assessment.

Unit III
Negotiation concepts; distributive and integrative negotiation; negotiation process stages; preparation and planning; bargaining strategies; outcomes management.

Unit IV
Power and influence; persuasion techniques; conflict management; stakeholder negotiation; cross cultural negotiation considerations.

Unit V
Ethical leadership; values based leadership; corporate governance linkages; leadership challenges in start-ups; crisis leadership perspectives.

Text Books

1. Northouse, P. G. (2021). *Leadership: Theory and practice* (9th ed.). Sage Publications.
2. Yukl, G. (2020). *Leadership in organizations* (9th ed.). Pearson.
3. Lewicki, R. J., Barry, B., & Saunders, D. M. (2020). *Negotiation* (8th ed.). McGraw-Hill Education.
4. Ireland, R. D., Hoskisson, R. E., & Hitt, M. A. (2020). *Understanding business strategy*. Cengage Learning.
5. Ciulla, J. B. (2019). *Ethics, the heart of leadership*. Praeger.

Reference Books

1. Kotter, J. P. (2018). *Leading change*. Harvard Business Review Press.
2. Fisher, R., Ury, W., & Patton, B. (2019). *Getting to yes*. Penguin.
3. Mintzberg, H. (2018). *Managers not MBAs*. Berrett-Koehler.
4. George, B. (2019). *Authentic leadership*. Wiley.
5. Lussier, R. N., & Achua, C. F. (2020). *Leadership*. Cengage Learning.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Risk Management & Business Sustainability

Course Category: Management & Functional Areas
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand business risk concepts and classifications
2. Analyze risk identification and assessment methods
3. Examine risk mitigation and control strategies
4. Understand sustainability principles and practices
5. Integrate risk management with sustainable growth

Course Outcomes

- CO1: Explain risk management concepts
- CO2: Identify and assess business risks

- CO3: Apply risk mitigation techniques
- CO4: Understand sustainability frameworks
- CO5: Integrate risk and sustainability strategies

Detailed Syllabus

Unit I
Risk concepts; types of business risks; strategic, operational, financial risks; uncertainty; risk perception; relevance to entrepreneurial ventures.

Unit II
Risk identification techniques; internal and external risks; risk assessment methods; qualitative and quantitative approaches; risk prioritization.

Unit III
Risk mitigation strategies; risk avoidance; risk reduction; risk transfer; insurance concepts; contingency planning.

Unit IV
Business sustainability concepts; triple bottom line; environmental, social, governance dimensions; sustainable business models.

Unit V
Enterprise risk management; sustainability integration; regulatory perspectives; reporting standards; long term value creation.

Text Books

1. Hopkin, P. (2018). *Fundamentals of risk management* (5th ed.). Kogan Page.
2. Fraser, J., & Simkins, B. (2019). *Enterprise risk management*. Wiley.
3. Carroll, A. B., & Brown, J. A. (2018). *Corporate social responsibility*. Sage.
4. Elkington, J. (2018). *Cannibals with forks*. Capstone.
5. Williams, C. A., Smith, M. L., & Young, P. C. (2020). *Risk management and insurance*. McGraw-Hill Education.

Reference Books

1. ISO 31000. (2018). *Risk management guidelines*. ISO.
2. Kaplan, R. S., & Mikes, A. (2019). *Managing risks*. Harvard Business Review.
3. Porter, M. E., & Kramer, M. R. (2019). *Creating shared value*. Harvard Business Review.
4. Tricker, B. (2019). *Corporate governance*. Oxford University Press.
5. UN Global Compact. (2020). *Sustainability reporting*. United Nations.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Emerging Trends in Entrepreneurship

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand contemporary entrepreneurial trends
2. Analyze technology driven entrepreneurship models
3. Examine global and sectoral innovations
4. Understand future opportunities and challenges
5. Prepare for evolving entrepreneurial careers

Course Outcomes

- CO1: Explain emerging entrepreneurship trends
- CO2: Analyze technology enabled ventures
- CO3: Understand global entrepreneurship dynamics
- CO4: Evaluate future business opportunities
- CO5: Adapt entrepreneurial strategies to change

Detailed Syllabus

Unit I
Emerging entrepreneurship landscape; digital entrepreneurship; platform based ventures; gig economy; changing business paradigms.

Unit II
Technology driven trends; artificial intelligence; fintech; health tech; agri tech; application contexts; innovation potential.

Unit III
Global entrepreneurship; cross border ventures; international start-ups; global markets; cultural considerations.

Unit IV
Sustainable entrepreneurship; green ventures; social innovation; inclusive business models; impact orientation.

Unit V
Future of work; entrepreneurial careers; skills for future entrepreneurs; policy and ecosystem evolution.

Text Books

1. Kuratko, D. F. (2020). *Entrepreneurship* (10th ed.). Cengage Learning.
2. Nambisan, S. (2019). *Digital entrepreneurship*. MIS Quarterly.
3. Schumpeter, J. A. (2018). *Capitalism, socialism and democracy*. Routledge.
4. World Economic Forum. (2020). *Future of jobs report*. WEF.
5. OECD. (2021). *Entrepreneurship at a glance*. OECD.

Reference Books

1. Isenberg, D. (2019). *Worthless, impossible and stupid*. Harvard Business Review Press.
2. Mazzucato, M. (2018). *The entrepreneurial state*. Penguin.
3. Christensen, C. M. (2019). *The innovator's dilemma*. Harvard Business Review Press.
4. Rifkin, J. (2019). *The zero marginal cost society*. Palgrave.
5. UNDP. (2020). *Innovation and entrepreneurship*. United Nations.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (Global Entrepreneurship / MSME Management)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand elective domain specific entrepreneurship
2. Analyze global or MSME business environments
3. Examine policy and institutional frameworks
4. Apply entrepreneurial strategies in selected domain
5. Promote global and MSME orientation

Course Outcomes

- CO1: Explain elective domain concepts

- CO2: Analyze global or MSME opportunities
- CO3: Understand operational and policy issues
- CO4: Apply management frameworks
- CO5: Evaluate growth and sustainability

Detailed Syllabus

Unit I
Global entrepreneurship or MSME overview; scope; characteristics; economic significance; competitive environment.

Unit II
Business models; internationalization strategies or MSME operations; market access; value chain perspectives.

Unit III
Policy support; export promotion; MSME development schemes; institutional support mechanisms.

Unit IV
Challenges and risks; finance; technology adoption; competitiveness; resilience strategies.

Unit V
Future trends; digital globalization; MSME transformation; inclusive growth opportunities.

Text Books

1. Cavusgil, S. T., Knight, G., & Riesenberger, J. R. (2020). *International business*. Pearson.
2. Storey, D. J. (2019). *Understanding the small business sector*. Routledge.
3. Hill, C. W. L. (2021). *International business*. McGraw-Hill Education.
4. OECD. (2020). *SME and entrepreneurship outlook*. OECD.
5. World Bank. (2020). *Doing business reports*. World Bank Publications.

Reference Books

1. Daniels, J. D., Radebaugh, L. H., & Sullivan, D. P. (2019). *International business*. Pearson.
2. Khanna, T. (2019). *Trust*. Penguin.
3. Acs, Z. J., & Audretsch, D. B. (2018). *Handbook of entrepreneurship research*. Springer.
4. UNCTAD. (2020). *World investment report*. United Nations.
5. Ministry of MSME. (2021). *MSME annual report*. Government of India.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project (Start-up / Industry / Research Based)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Integrate complete program learning outcomes
2. Execute comprehensive project or start-up initiative
3. Apply research, analysis, and innovation skills
4. Demonstrate professional project management
5. Prepare for entrepreneurial or professional careers

Course Outcomes

- CO1: Identify complex business or research problems
- CO2: Apply advanced analytical and strategic tools
- CO3: Develop viable solutions or ventures
- CO4: Demonstrate independent execution capability
- CO5: Present professional quality project outcomes

Guidelines

Project proposal approval; literature or market review; methodology design; implementation or venture execution; progress reviews; final report and presentation.

Evaluation Scheme

Continuous Assessment (30%) + Final Project Evaluation (70%)

Seminar / Viva-Voce

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop academic and professional presentation skills
2. Enhance critical thinking and articulation ability

3. Demonstrate subject mastery
4. Prepare for viva and professional interaction
5. Support transition to career or entrepreneurship

Course Outcomes

- CO1: Conduct structured seminar presentations
- CO2: Demonstrate subject knowledge depth
- CO3: Respond effectively to evaluation questions
- CO4: Apply analytical and communication skills
- CO5: Exhibit professional confidence

Guidelines

Topic selection; literature review; seminar presentation; questioning and discussion; viva voce examination; faculty panel evaluation.

Evaluation Scheme

Seminar Presentation (50%) + Viva-Voce Examination (50%)

SEMESTER VII

Advanced Strategic Entrepreneurship

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced entrepreneurial strategic thinking capabilities
2. Analyze opportunity driven competitive strategy under uncertainty
3. Examine resource orchestration and dynamic capability creation
4. Understand strategic renewal, innovation, and transformation
5. Apply strategic entrepreneurship frameworks to complex ventures

Course Outcomes

- **CO1:** Formulate entrepreneurial strategies under dynamic conditions
- **CO2:** Analyze opportunity based and resource based advantages
- **CO3:** Apply strategic tools for uncertainty and disruption
- **CO4:** Evaluate renewal and transformation pathways
- **CO5:** Design sustainable strategic entrepreneurship models

Detailed Syllabus

Unit I
Strategic entrepreneurship foundations; entrepreneurial orientation dimensions; opportunity driven strategy; strategic intent; value creation mechanisms; uncertainty, risk, and ambiguity contexts; competitive advantage logic in entrepreneurial firms.

Unit II
Opportunity identification and exploitation; environmental scanning; opportunity evaluation frameworks; resource orchestration; dynamic capabilities; strategic flexibility; entrepreneurial decision making under imperfect information.

Unit III
Competitive positioning for start-ups; industry disruption patterns; blue ocean strategies; innovation based competition; first mover advantages; imitation risks; strategic timing and market entry choices.

Unit IV
Corporate entrepreneurship; strategic renewal; business model innovation; organizational ambidexterity; turnaround and transformation strategies; leadership role in strategic change.

Unit V

Sustaining entrepreneurial advantage; growth versus profitability trade-offs; long term value creation; strategic governance; ethical strategy; global competitive positioning of entrepreneurial ventures.

Text Books

1. Ireland, R. D., Hitt, M. A., & Sirmon, D. G. (2020). *Strategic entrepreneurship*. Cengage Learning.
2. Kuratko, D. F. (2020). *Entrepreneurship* (10th ed.). Cengage Learning.
3. Grant, R. M. (2020). *Contemporary strategy analysis*. Wiley.
4. Johnson, G., Scholes, K., & Whittington, R. (2020). *Exploring strategy*. Pearson.
5. Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2020). *Strategic management*. Cengage Learning.

Reference Books

1. Rumelt, R. (2018). *Good strategy bad strategy*. Crown Business.
2. Teece, D. J. (2019). *Dynamic capabilities*. Oxford University Press.
3. Porter, M. E. (2019). *Competitive advantage*. Free Press.
4. Mintzberg, H. (2018). *Strategy safari*. Free Press.
5. Christensen, C. M. (2019). *The innovator's dilemma*. Harvard Business Review Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Start-up Failure Analysis & Turnaround Strategies

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand multidimensional causes of start-up failure
2. Analyze financial, strategic, and operational distress
3. Identify early warning indicators of failure
4. Examine structured turnaround and recovery strategies
5. Build resilience and learning from failure

Course Outcomes

- **CO1:** Classify types and causes of start-up failure
- **CO2:** Analyze financial and operational distress signals
- **CO3:** Evaluate turnaround and pivot strategies
- **CO4:** Apply recovery and restructuring frameworks
- **CO5:** Develop entrepreneurial resilience and learning

Detailed Syllabus

Unit I
Concept of start-up failure; failure versus exit; failure typologies; internal and external causes; liability of newness; environmental uncertainty; entrepreneurial risk exposure.

Unit II
Financial distress analysis; cash flow mismanagement; burn rate and runway analysis; funding gaps; revenue instability; governance and control weaknesses.

Unit III
Strategic and operational failures; product market misfit; flawed scaling decisions; leadership and team failures; execution breakdown; organizational misalignment.

Unit IV
Turnaround strategies; retrenchment and cost restructuring; strategic repositioning; pivot models; crisis leadership; stakeholder communication during recovery.

Unit V
Learning from failure; resilience building; re-entrepreneurship; ecosystem and policy support mechanisms; ethical handling of failure; long term capability development.

Text Books

1. Shepherd, D. A. (2020). *Entrepreneurial failure*. Edward Elgar.
2. Coelho, P. R. (2019). *Startup failures*. Springer.
3. Argenti, J. (2018). *Corporate collapse*. McGraw-Hill.
4. Ries, E. (2017). *The lean startup*. Crown Business.
5. Bessant, J. (2019). *Innovation and failure*. Wiley.

Reference Books

1. Mullins, J. (2019). *The new business road test*. Pearson.
2. McGrath, R. G. (2019). *Seeing around corners*. Houghton Mifflin.
3. Sutton, R. I., & Rao, H. (2019). *Scaling up excellence*. Crown Business.

4. OECD. (2020). *Entrepreneurship policy review*. OECD.
5. Hamel, G. (2019). *Humanocracy*. Harvard Business Review Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Global Start-up Ecosystems & International Markets

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Detailed Syllabus

Unit I
Global entrepreneurship concepts; comparative study of start-up ecosystems; Silicon Valley, Israel, Europe, Asia; ecosystem components; innovation culture; funding and talent dynamics.

Unit II
International market opportunity analysis; market selection frameworks; demand assessment; customer adaptation; competitive positioning in global markets.

Unit III
Internationalization strategies; exporting; licensing; alliances; joint ventures; born global firms; scaling ventures across borders.

Unit IV
Cultural, institutional, and regulatory differences; political and economic risks; global compliance challenges; risk mitigation strategies.

Unit V
Global funding and support systems; international accelerators; cross border venture capital; global policy frameworks; future trends in global entrepreneurship.

(Objectives, Outcomes, Books, Evaluation Scheme same structure and rigor as Course 1)

Course 4: Data-Driven Decision Making for Entrepreneurs

Course Category: Management & Functional Areas
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Detailed Syllabus

Unit I
Entrepreneurial decision environments; data driven thinking; bounded rationality; cognitive biases; evidence based management in start-ups.

Unit II
Advanced descriptive analytics; dashboards; performance metrics; key entrepreneurial indicators; visualization for strategic insight.

Unit III
Predictive analytics foundations; forecasting techniques; scenario planning; sensitivity analysis; revenue and cost projections.

Unit IV
Decision making under uncertainty; risk analytics; simulation concepts; trade-off analysis; managerial judgment integration.

Unit V
Analytics governance; ethical data use; privacy concerns; data driven culture; strategic integration of analytics in ventures.

Professional Elective II (Tech Start-ups / Impact Investing)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Detailed Syllabus

Unit I
Sector overview; technology driven or impact focused ventures; ecosystem structure; value creation logic; stakeholder orientation.

Unit II
Business models; revenue mechanisms; scalability drivers; funding structures; venture life cycle considerations.

Unit III
Technology or impact measurement frameworks; risk assessment; regulatory and ethical dimensions.

Unit IV
Growth and scaling challenges; governance models; performance management; sustainability integration.

Unit V
Future trends; global perspectives; policy support; long term value creation in elective domain.

Internship (Incubator / VC / Start-Up)

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Guidelines

Full semester professional attachment; defined entrepreneurial or investment tasks; mentor supervision; operational exposure; analytical reporting; faculty assessment.

Evaluation Scheme

Internship Performance (60%) + Report Evaluation (40%)

Major Project Phase II

Course Category: Project Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Guidelines

Continuation of major project; milestone based progress; supervisor evaluation; readiness for final project phase.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER VIII

Corporate Governance & Ethics for Start-ups

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand governance systems applicable to entrepreneurial ventures
2. Analyze ethical responsibilities of founders and leadership teams
3. Examine board structures, accountability, and transparency mechanisms
4. Study governance failures and compliance challenges in start-ups
5. Apply ethical governance practices for sustainable venture growth

Course Outcomes

- **CO1:** Explain corporate governance principles for start-ups
- **CO2:** Analyze ethical issues and conflicts in entrepreneurial firms
- **CO3:** Evaluate governance structures and internal controls
- **CO4:** Apply compliance and accountability mechanisms
- **CO5:** Promote responsible and ethical entrepreneurship

Detailed Syllabus

Unit I
Corporate governance concepts; evolution of governance; relevance for start-ups; founders, investors, stakeholders; agency problems; governance challenges during early and growth stages.

Unit II
Board structures; roles of directors; advisory boards; governance committees; decision rights; accountability systems; transparency, disclosure, and reporting practices.

Unit III
Business ethics foundations; ethical theories; values and integrity; ethical decision frameworks; conflicts of interest; ethical leadership in entrepreneurial organizations.

Unit IV
Governance failures; start-up and corporate scandals; risk oversight; whistleblowing systems; compliance mechanisms; internal control frameworks and audit functions.

Unit V

ESG principles; responsible entrepreneurship; sustainability governance; stakeholder capitalism; global governance standards; trust building and long-term legitimacy.

Text Books

1. Tricker, B. (2019). *Corporate governance* (4th ed.). Oxford University Press.
2. Solomon, J. (2020). *Corporate governance and accountability*. Wiley.
3. Mallin, C. A. (2019). *Corporate governance* (6th ed.). Oxford University Press.
4. Ciulla, J. B. (2019). *Ethics, the heart of leadership*. Praeger.
5. Crane, A., & Matten, D. (2021). *Business ethics*. Oxford University Press.

Reference Books

1. Cadbury, A. (2018). *Corporate governance and chairmanship*. Oxford University Press.
2. Freeman, R. E. (2019). *Strategic management: A stakeholder approach*. Cambridge University Press.
3. OECD. (2020). *Principles of corporate governance*. OECD.
4. Velasquez, M. (2020). *Business ethics*. Pearson.
5. UN Global Compact. (2020). *Corporate sustainability*. United Nations.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Research Methods & Case Writing in Entrepreneurship

Course Category: Entrepreneurship & Innovation Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand research methods used in entrepreneurship studies
2. Develop applied and academic research skills
3. Learn systematic case study design and writing
4. Analyze entrepreneurial phenomena using research tools
5. Prepare for research, consultancy, and doctoral pathways

Course Outcomes

- **CO1:** Explain research designs and methodologies

- **CO2:** Conduct entrepreneurship-focused research studies
- **CO3:** Develop structured and publishable case studies
- **CO4:** Analyze qualitative and quantitative research data
- **CO5:** Present research and case findings professionally

Detailed Syllabus

Unit I
Nature of research; entrepreneurship research areas; research questions; objectives; hypotheses formulation; exploratory, descriptive, and causal research designs.

Unit II
Research methodology; qualitative methods; quantitative methods; mixed approaches; sampling techniques; primary and secondary data sources.

Unit III
Data analysis techniques; basic statistical tools; coding and thematic analysis; interpretation of results; validity and reliability considerations.

Unit IV
Case study method; case selection; field research; interviews; observation; narrative structuring; teaching and research cases.

Unit V
Research ethics; plagiarism avoidance; referencing styles; publication process; case writing for journals; policy and practice relevance.

Text Books

1. Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students*. Pearson.
2. Yin, R. K. (2018). *Case study research and applications*. Sage.
3. Creswell, J. W. (2018). *Research design*. Sage.
4. Eisenhardt, K. M. (2019). *Building theories from case study research*. Sage.
5. Sekaran, U., & Bougie, R. (2020). *Research methods for business*. Wiley.

Reference Books

1. Bryman, A. (2019). *Social research methods*. Oxford University Press.
2. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2020). *Multivariate data analysis*. Cengage.
3. Stake, R. E. (2018). *The art of case study research*. Sage.
4. APA. (2020). *Publication manual of the APA* (7th ed.). APA.

5. Kothari, C. R. (2019). *Research methodology*. New Age.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Policy, Regulation & Compliance for New Ventures

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand policy frameworks influencing entrepreneurship
2. Analyze regulatory systems affecting start-ups
3. Examine legal and statutory compliance requirements
4. Study taxation, reporting, and disclosure norms
5. Apply regulatory knowledge to venture operations

Course Outcomes

- **CO1:** Explain policy and regulatory structures
- **CO2:** Analyze compliance requirements for start-ups
- **CO3:** Understand taxation and statutory reporting
- **CO4:** Apply regulatory strategies in ventures
- **CO5:** Evaluate policy impact on start-up growth

Detailed Syllabus

Unit I
Public policy foundations; economic regulation; role of government; regulatory institutions; policy objectives for entrepreneurship promotion.

Unit II
Start-up regulations; business incorporation; labor laws; environmental regulations; sector-specific compliance obligations.

Unit III
Taxation systems; direct taxes; indirect taxes; GST framework; start-up incentives; exemptions and compliance procedures.

Unit IV
Reporting and disclosure requirements; statutory filings; audits; penalties; enforcement mechanisms; compliance risk management.

Unit V

Policy reforms; ease of doing business; global regulatory comparisons; emerging compliance trends; regulatory strategy formulation.

Text Books

1. Sharma, J. P. (2020). *Business law*. Ane Books.
2. Majumdar, A. K. (2020). *Company law and practice*. Taxmann.
3. OECD. (2020). *Entrepreneurship policy framework*. OECD.
4. World Bank. (2020). *Doing business reports*. World Bank.
5. Government of India. (2021). *Start-up India policy documents*. GoI.

Reference Books

1. North, D. C. (2019). *Institutions, institutional change*. Cambridge University Press.
2. Acs, Z. J., & Szerb, L. (2018). *Global entrepreneurship index*. Springer.
3. UNCTAD. (2020). *Entrepreneurship policy framework*. United Nations.
4. Jain, N. (2021). *Business laws*. Taxmann.
5. Khanna, T. (2019). *Trust*. Penguin.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective III (Interdisciplinary)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Expose learners to interdisciplinary knowledge integration
2. Link entrepreneurship with allied academic domains
3. Analyze cross-disciplinary problem-solving approaches
4. Encourage innovation across diverse fields
5. Support diversified professional pathways

Course Outcomes

- **CO1:** Explain interdisciplinary concepts
- **CO2:** Integrate knowledge across multiple domains

- **CO3:** Analyze complex interdisciplinary problems
- **CO4:** Apply entrepreneurial thinking beyond business
- **CO5:** Evaluate interdisciplinary innovation outcomes

Detailed Syllabus

Unit I
Interdisciplinary foundations; convergence of disciplines; entrepreneurship interfaces with technology, health sciences, design, and social sciences.

Unit II
Problem identification across disciplines; systems thinking; integrative analytical frameworks; opportunity recognition in complex environments.

Unit III
Innovation at disciplinary intersections; collaboration models; cross-functional teams; coordination and knowledge integration challenges.

Unit IV
Application cases; interdisciplinary start-ups; technology driven ventures; design led innovation; societal impact assessment.

Unit V
Future interdisciplinary trends; emerging domains; continuous learning; entrepreneurial adaptability in changing knowledge ecosystems.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Integrated Honours Project / Venture Launch

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Integrate complete programme learning outcomes
2. Execute venture launch or applied research project
3. Demonstrate innovation, analysis, and execution capability
4. Apply strategic, financial, and operational tools
5. Prepare for entrepreneurial or professional careers

Course Outcomes

- **CO1:** Identify complex entrepreneurial or research problems

- **CO2:** Design viable venture or research solutions
- **CO3:** Execute project with professional rigor
- **CO4:** Demonstrate independent decision-making ability
- **CO5:** Present high-quality project outcomes

Guidelines

Project proposal approval; venture launch or research execution; milestone reviews; final report submission; demonstration or project defense.

Evaluation Scheme

Continuous Assessment (30%) + Final Project Evaluation (70%)

Viva-Voce / Portfolio Evaluation

Course Category: Humanities & Management Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Assess overall programme learning outcomes
2. Evaluate professional and entrepreneurial readiness
3. Review integrated project and academic portfolio
4. Examine reflective learning and competence development
5. Support transition to career or venture

Course Outcomes

- **CO1:** Demonstrate comprehensive programme knowledge
- **CO2:** Articulate project and portfolio outcomes
- **CO3:** Exhibit analytical and reflective capability
- **CO4:** Defend decisions and methodologies
- **CO5:** Display professional confidence and clarity

Guidelines

Portfolio submission; viva-voce examination; expert panel evaluation; holistic competency assessment.

Evaluation Scheme

Viva-Voce Examination (100%)

MBA – Start-up Failure Analytics & Case Research

Duration: 2 Years | 4 SEMESTERs | Total Credits: 80

SEMESTER I

Managerial Economics

Course Category: Management Foundations & Economics
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop economic reasoning for managerial decision-making
2. Analyze demand, supply, and market structures
3. Apply cost concepts to business operations
4. Evaluate pricing and output decisions
5. Integrate macroeconomic factors into strategic planning

Course Outcomes

- CO1: Apply microeconomic principles to managerial decisions
- CO2: Analyze demand, supply, elasticity, and forecasting models
- CO3: Evaluate production and cost functions
- CO4: Assess market structures and pricing strategies
- CO5: Interpret macroeconomic indicators affecting business

Detailed Syllabus

Unit I
Managerial economics, scope, relevance; microeconomic foundations, opportunity cost, marginal analysis; demand concepts, determinants, law of demand; demand estimation techniques, demand forecasting methods; elasticity of demand, measurement, business applications; managerial decision contexts.

Unit II
Production theory, production function, short-run and long-run analysis; law of variable proportions, returns to scale; isoquants, isocosts, producer equilibrium; cost concepts, accounting versus economic cost; short-run and long-run cost curves; economies of scale.

Unit III
Market structures, perfect competition characteristics; price and output determination, firm

and industry equilibrium; monopoly features, price discrimination, regulation; monopolistic competition, product differentiation; oligopoly models, kinked demand, cartels; strategic interactions.

Unit IV
Pricing practices, cost-plus pricing, marginal pricing; pricing under uncertainty; peak-load pricing, transfer pricing; game theory basics, payoff matrix; business strategy applications; managerial implications of competitive behavior; decision-making under risk.

Unit V
Macroeconomic environment, national income concepts; inflation, deflation, business cycles; fiscal policy, monetary policy instruments; interest rates, money supply; economic planning in India; macroeconomic indicators, impact on business strategy and investment decisions.

Text Books

1. Samuelson, P. A., & Nordhaus, W. D. (2018). *Economics* (19th ed.). McGraw-Hill Education.
2. McConnell, C. R., Brue, S. L., & Flynn, S. M. (2021). *Economics: Principles, problems, and policies* (21st ed.). McGraw-Hill Education.
3. Salvatore, D. (2019). *Managerial economics in a global economy* (9th ed.). Oxford University Press.
4. Keat, P. G., Young, P. K. Y., & Erfle, S. E. (2020). *Managerial economics: Economic tools for today's decision makers* (8th ed.). Pearson.
5. Pindyck, R. S., & Rubinfeld, D. L. (2020). *Microeconomics* (9th ed.). Pearson.

Reference Books

1. Baye, M. R., & Prince, J. T. (2020). *Managerial economics and business strategy* (10th ed.). McGraw-Hill Education.
2. Varian, H. R. (2019). *Intermediate microeconomics: A modern approach* (9th ed.). W. W. Norton.
3. Mankiw, N. G. (2021). *Principles of economics* (9th ed.). Cengage Learning.
4. Lipsey, R. G., & Chrystal, K. A. (2019). *Economics* (13th ed.). Oxford University Press.
5. Dornbusch, R., Fischer, S., & Startz, R. (2018). *Macroeconomics* (13th ed.). McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Management Principles & Organizational Behaviour

Course Category: Management Foundations
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand core management principles and functions
2. Analyze organizational structures and design
3. Examine individual and group behavior in organizations
4. Develop leadership and motivation perspectives
5. Enhance managerial effectiveness and decision-making

Course Outcomes

- CO1: Apply management functions in organizational contexts
- CO2: Analyze organizational structures and cultures
- CO3: Assess individual behavior and motivation theories
- CO4: Evaluate group dynamics and leadership styles
- CO5: Apply organizational behavior concepts to managerial practice

Detailed Syllabus

Unit I
Nature of management, evolution of management thought; planning concepts, objectives, strategies; decision-making process, rationality, bounded rationality; organizing principles, authority, responsibility; coordination mechanisms; managerial roles and skills.

Unit II
Organizational structure, functional, divisional, matrix forms; organizational design, span of control; formal and informal organization; organizational culture, values, ethics; change management fundamentals; organizational effectiveness measures.

Unit III
Individual behavior, personality, perception, attitudes; learning theories, reinforcement; motivation concepts, Maslow, Herzberg, McClelland; job satisfaction, engagement; managerial implications for performance improvement.

Unit IV
Group behavior, group formation, norms, cohesion; teams, team effectiveness; leadership theories, trait, behavioral, contingency; power, influence, politics; conflict management styles; negotiation fundamentals.

Unit V
Communication process, barriers, organizational communication; stress management, work-

life balance; organizational development interventions; contemporary issues in organizational behavior; diversity management; managerial challenges in dynamic environments.

Text Books

1. Robbins, S. P., & Judge, T. A. (2020). *Organizational behavior* (18th ed.). Pearson.
2. Koontz, H., Weihrich, H., & Cannice, M. (2020). *Essentials of management* (10th ed.). McGraw-Hill Education.
3. Griffin, R. W. (2019). *Management* (13th ed.). Cengage Learning.
4. Luthans, F. (2018). *Organizational behavior* (12th ed.). McGraw-Hill Education.
5. George, J. M., & Jones, G. R. (2021). *Understanding and managing organizational behavior* (8th ed.). Pearson.

Reference Books

1. Daft, R. L. (2020). *Management* (14th ed.). Cengage Learning.
2. Hellriegel, D., & Slocum, J. W. (2019). *Organizational behavior* (14th ed.). Cengage Learning.
3. Miner, J. B. (2018). *Organizational behavior* (2nd ed.). Routledge.
4. Greenberg, J. (2019). *Behavior in organizations* (11th ed.). Pearson.
5. Mullins, L. J. (2016). *Management and organizational behavior* (11th ed.). Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Financial Accounting & Analysis

Course Category: Management Foundations
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fundamental accounting principles and standards
2. Develop skills in preparation of financial statements
3. Analyze financial performance and position of firms
4. Interpret accounting information for managerial decisions
5. Evaluate financial data for investment and control purposes

Course Outcomes

- CO1: Apply accounting concepts and conventions

- CO2: Prepare basic financial statements
- CO3: Analyze financial statements using ratios
- CO4: Interpret accounting information for decisions
- CO5: Evaluate financial health and performance

Detailed Syllabus

Unit I
Accounting concepts, principles, conventions; accounting standards overview; accounting equation; double entry system; journal, ledger, trial balance; capital and revenue items; depreciation concepts; inventory valuation methods; accounting cycle fundamentals.

Unit II
Preparation of financial statements; trading account, profit and loss account; balance sheet; adjustments; final accounts of sole proprietorship; manufacturing account basics; accounting for non-profit organizations overview; presentation formats.

Unit III
Analysis of financial statements; horizontal, vertical analysis; comparative statements; common-size statements; trend analysis; interpretation of financial performance indicators; limitations of financial statement analysis.

Unit IV
Ratio analysis concepts; liquidity ratios; profitability ratios; solvency ratios; efficiency ratios; market value ratios; inter-firm comparison; managerial interpretation; limitations of ratio analysis.

Unit V
Cash flow statement; objectives and uses; operating, investing, financing activities; preparation as per accounting standards; fund flow statement overview; working capital changes; managerial applications of cash flow information.

Text Books

1. Tulsian, P. C., & Tulsian, B. (2021). *Financial accounting* (2nd ed.). Pearson.
2. Kimmel, P. D., Weygandt, J. J., & Kieso, D. E. (2020). *Accounting tools for business decision making* (9th ed.). Wiley.
3. Grewal, T. S., & Gupta, S. (2020). *Introduction to accounting*. Sultan Chand.
4. Narayanaswamy, R. (2021). *Financial accounting: A managerial perspective* (6th ed.). McGraw-Hill Education.
5. Libby, R., Libby, P. A., & Short, D. G. (2021). *Financial accounting* (10th ed.). McGraw-Hill Education.

Reference Books

1. Anthony, R. N., Hawkins, D. F., & Merchant, K. A. (2019). *Accounting: Text and cases* (13th ed.). McGraw-Hill Education.
2. Warren, C. S., Reeve, J. M., & Duchac, J. E. (2020). *Financial accounting* (15th ed.). Cengage Learning.
3. Penman, S. H. (2018). *Financial statement analysis and security valuation* (5th ed.). McGraw-Hill Education.
4. Bhattacharyya, A. K. (2020). *Financial accounting* (5th ed.). Prentice Hall India.
5. Stickney, C. P., Weil, R. L., Schipper, K., & Francis, J. (2019). *Financial accounting* (14th ed.). McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Business Statistics & Quantitative Methods

Course Category: Quantitative Methods & Analytics
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop statistical thinking for managerial decision making
2. Apply descriptive and inferential statistical tools
3. Analyze business data using probability concepts
4. Interpret quantitative results for management problems
5. Support decision making through statistical modeling

Course Outcomes

- CO1: Apply descriptive statistical techniques
- CO2: Use probability concepts in business contexts
- CO3: Perform statistical inference
- CO4: Analyze relationships using correlation and regression
- CO5: Apply quantitative tools to managerial decisions

Detailed Syllabus

Unit I
Statistics scope; data types; data collection methods; classification, tabulation; measures of central tendency; mean, median, mode; measures of dispersion; range, variance, standard deviation; graphical presentation techniques.

Unit II
Probability concepts; classical, empirical probability; addition, multiplication rules; conditional probability; Bayes theorem; random variables; probability distributions; binomial distribution; normal distribution; managerial applications.

Unit III
Sampling concepts; sampling methods; sampling distributions; estimation concepts; point and interval estimation; confidence intervals for means and proportions; sample size determination; business applications.

Unit IV
Hypothesis testing; null and alternative hypotheses; type I and II errors; tests of significance; z test, t test; chi-square test; ANOVA basics; interpretation of results for management decisions.

Unit V
Correlation analysis; types of correlation; regression analysis; simple linear regression; estimation and interpretation of regression coefficients; forecasting applications; limitations of quantitative methods; decision support relevance.

Text Books

1. Levin, R. I., Rubin, D. S., Rastogi, S., & Siddiqui, M. H. (2020). *Statistics for management* (8th ed.). Pearson.
2. Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., & Cochran, J. J. (2020). *Statistics for business and economics* (14th ed.). Cengage Learning.
3. Gupta, S. C., & Kapoor, V. K. (2019). *Fundamentals of mathematical statistics*. Sultan Chand.
4. Keller, G. (2021). *Statistics for management and economics* (11th ed.). Cengage Learning.
5. Newbold, P., Carlson, W. L., & Thorne, B. M. (2020). *Statistics for business and economics* (9th ed.). Pearson.

Reference Books

1. Spiegel, M. R., Schiller, J., & Srinivasan, R. A. (2018). *Probability and statistics*. McGraw-Hill Education.
2. Berenson, M. L., Levine, D. M., & Szabat, K. A. (2020). *Basic business statistics* (14th ed.). Pearson.
3. Freund, J. E., & Perles, B. M. (2017). *Modern elementary statistics*. Pearson.
4. Lind, D. A., Marchal, W. G., & Wathen, S. A. (2019). *Statistical techniques in business and economics* (17th ed.). McGraw-Hill Education.
5. Black, K. (2019). *Business statistics: Contemporary decision making* (9th ed.). Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Research Methodology for Management Studies

Course Category: Quantitative Methods & Analytics
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand foundations of management research
2. Develop research problem formulation skills
3. Apply research design and methodology concepts
4. Analyze data using appropriate techniques
5. Prepare structured research reports

Course Outcomes

- CO1: Formulate research problems and objectives
- CO2: Design appropriate research methodologies
- CO3: Apply data collection techniques
- CO4: Analyze and interpret research data
- CO5: Prepare academic research reports

Detailed Syllabus

Unit I
Research concepts; scientific inquiry; management research scope; research process stages; research problem identification; objectives formulation; hypotheses development; variables, constructs; managerial relevance of research.

Unit II
Research designs; exploratory, descriptive, causal designs; qualitative, quantitative approaches; sampling concepts; sampling techniques; sample size determination; measurement scales; reliability and validity concepts.

Unit III
Data collection methods; primary data; questionnaires; interviews; observation; secondary data sources; research ethics; plagiarism issues; data quality control; pilot study importance.

Unit IV
Data analysis techniques; descriptive analysis; inferential statistics overview; hypothesis

testing relevance; qualitative data analysis basics; interpretation of results; managerial implications.

Unit V
Research report writing; structure and format; literature review techniques; citation styles; referencing standards; presentation of findings; managerial recommendations; research limitations and future scope.

Text Books

1. Kothari, C. R., & Garg, G. (2019). *Research methodology* (4th ed.). New Age International.
2. Sekaran, U., & Bougie, R. (2020). *Research methods for business* (8th ed.). Wiley.
3. Cooper, D. R., & Schindler, P. S. (2020). *Business research methods* (13th ed.). McGraw-Hill Education.
4. Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson.
5. Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2020). *Business research methods* (14th ed.). Cengage Learning.

Reference Books

1. Creswell, J. W. (2018). *Research design* (5th ed.). Sage.
2. Bryman, A., & Bell, E. (2015). *Business research methods* (4th ed.). Oxford University Press.
3. Yin, R. K. (2018). *Case study research and applications* (6th ed.). Sage.
4. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.
5. Bell, J., & Waters, S. (2018). *Doing your research project* (7th ed.). Open University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Business Communication & Professional Skills

Course Category: Communication, Ethics & Policy Studies
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop effective managerial communication skills

2. Enhance professional writing and presentation abilities
3. Improve interpersonal and group communication
4. Build professional etiquette and workplace skills
5. Prepare for corporate communication requirements

Course Outcomes

- CO1: Apply principles of effective business communication
- CO2: Prepare professional written documents
- CO3: Deliver structured oral presentations
- CO4: Demonstrate interpersonal communication competence
- CO5: Exhibit professional etiquette and conduct

Detailed Syllabus

Unit I
Communication concepts; communication process; barriers to communication; business communication principles; verbal and non-verbal communication; listening skills; cross-cultural communication basics.

Unit II
Business writing fundamentals; emails, memos, reports; clarity, tone, structure; business correspondence formats; grammar essentials; proofreading techniques; professional documentation standards.

Unit III
Oral communication skills; presentations planning; visual aids usage; public speaking techniques; group discussions; meetings management; persuasive communication skills.

Unit IV
Interpersonal communication; negotiation basics; conflict handling; emotional intelligence; team communication; leadership communication styles; feedback mechanisms.

Unit V
Professional skills development; corporate etiquette; interview skills; resume preparation; workplace ethics; time management; personal branding; career communication strategies.

Text Books

1. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2020). *Business communication* (14th ed.). McGraw-Hill Education.
2. Bovee, C. L., & Thill, J. V. (2021). *Business communication today* (15th ed.). Pearson.
3. Murphy, H. A., Hildebrandt, H. W., & Thomas, J. P. (2018). *Effective business communications*. McGraw-Hill Education.

4. Chaney, L. H., & Martin, J. S. (2019). *Intercultural business communication* (6th ed.). Pearson.
5. Adler, R. B., Rodman, G., & du Pré, A. (2020). *Understanding human communication* (14th ed.). Oxford University Press.

Reference Books

1. Guffey, M. E., & Loewy, D. (2021). *Essentials of business communication* (11th ed.). Cengage Learning.
2. Pease, A., & Pease, B. (2016). *The definitive book of body language*. Orion.
3. Covey, S. R. (2020). *The 7 habits of highly effective people*. Simon & Schuster.
4. Carnegie, D. (2019). *How to win friends and influence people*. Vermilion.
5. Barrett, D. J. (2018). *Leadership communication*. McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Industry Orientation / Field Study

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to industry environments
2. Relate management concepts to real organizations
3. Develop observational and analytical skills
4. Enhance professional awareness and ethics
5. Prepare for advanced industry engagement

Course Outcomes

- CO1: Identify organizational structures and processes
- CO2: Relate theory with practical industry operations
- CO3: Demonstrate professional conduct and reporting skills
- CO4: Analyze industry practices and challenges
- CO5: Present structured field study findings

Guidelines

- Industry visits, interaction with managers, structured observation
- Field study report preparation, institutional guidelines compliance

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER II

Marketing Management

Course Category: Management Foundations
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop analytical understanding of marketing concepts and frameworks
2. Examine consumer behavior and market segmentation approaches
3. Analyze product, pricing, and distribution decisions
4. Evaluate integrated marketing communication strategies
5. Apply marketing decision tools in competitive environments

Course Outcomes

- CO1: Apply core marketing concepts in managerial contexts
- CO2: Analyze consumer behavior and market segmentation
- CO3: Evaluate product and pricing strategies
- CO4: Assess distribution and promotional decisions
- CO5: Integrate marketing strategies for competitive advantage

Detailed Syllabus

Unit I
Marketing concepts, evolution, scope; marketing environment, micro and macro factors; customer value, satisfaction, relationship marketing; strategic marketing planning process; market-oriented organizational structures; ethical, social, and sustainable marketing considerations.

Unit II
Consumer behavior models; psychological, social, cultural influences; organizational buying behavior; market segmentation bases, targeting strategies; positioning approaches, perceptual mapping; demand analysis; marketing research support for decision making.

Unit III
Product concepts, product life cycle; new product development stages; branding strategies, brand equity; pricing objectives, cost-based, value-based pricing; price sensitivity, competition-oriented pricing; pricing strategies across life cycle stages.

Unit IV
Marketing channels, channel design decisions; logistics, supply chain interfaces; retailing

formats; wholesaling functions; integrated marketing communications; advertising, sales promotion, public relations; digital marketing fundamentals; media planning considerations.

Unit V
Marketing control systems; sales forecasting techniques; marketing metrics, dashboards; competitive marketing strategies; global marketing challenges; services marketing characteristics; customer relationship management systems; contemporary marketing issues in dynamic markets.

Text Books

1. Kotler, P., Keller, K. L., Koshy, A., & Jha, M. (2021). *Marketing management* (16th ed.). Pearson.
2. Lamb, C. W., Hair, J. F., & McDaniel, C. (2020). *Marketing* (14th ed.). Cengage Learning.
3. Pride, W. M., & Ferrell, O. C. (2019). *Marketing* (19th ed.). Cengage Learning.
4. Kerin, R. A., Hartley, S. W., & Rudelius, W. (2021). *Marketing* (14th ed.). McGraw-Hill Education.
5. Czinkota, M. R., & Ronkainen, I. A. (2020). *International marketing* (11th ed.). Cengage Learning.

Reference Books

1. Aaker, D. A. (2018). *Strategic market management* (11th ed.). Wiley.
2. Solomon, M. R. (2020). *Consumer behavior* (13th ed.). Pearson.
3. Ries, A., & Trout, J. (2019). *Positioning: The battle for your mind*. McGraw-Hill Education.
4. Blythe, J. (2017). *Principles and practice of marketing* (3rd ed.). Sage.
5. Chaffey, D., & Ellis-Chadwick, F. (2019). *Digital marketing* (7th ed.). Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Corporate Finance & Valuation

Course Category: Management Foundations
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop understanding of corporate finance principles
2. Analyze capital budgeting and financing decisions

3. Examine cost of capital and capital structure theories
4. Apply valuation models for firms and projects
5. Integrate risk considerations into financial decisions

Course Outcomes

- CO1: Apply corporate finance concepts in decision making
- CO2: Evaluate investment proposals using capital budgeting tools
- CO3: Analyze financing and dividend decisions
- CO4: Apply valuation techniques for firms and securities
- CO5: Assess financial risk and return trade-offs

Detailed Syllabus

Unit I
Corporate finance scope; financial objectives, shareholder value; time value of money concepts; compounding, discounting techniques; risk-return relationship; financial markets overview; role of financial manager; agency issues and governance considerations.

Unit II
Capital budgeting process; cash flow estimation; payback, discounted payback methods; net present value, internal rate of return; profitability index; project risk analysis; sensitivity, scenario analysis; capital rationing concepts.

Unit III
Cost of capital concepts; cost of debt, equity, preference shares; weighted average cost of capital; capital structure theories, net income, net operating income; Modigliani–Miller propositions; leverage analysis; financial risk implications.

Unit IV
Dividend policy theories; relevance, irrelevance approaches; dividend models; share repurchases; valuation of bonds, equity shares; dividend discount models; free cash flow valuation; relative valuation multiples.

Unit V
Working capital management; cash, receivables, inventory management; short-term financing sources; mergers and acquisitions basics; corporate restructuring; international finance overview; contemporary issues in corporate financial management.

Text Books

1. Brealey, R. A., Myers, S. C., & Allen, F. (2020). *Principles of corporate finance* (13th ed.). McGraw-Hill Education.
2. Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2022). *Fundamentals of corporate finance* (13th ed.). McGraw-Hill Education.

3. Damodaran, A. (2019). *Applied corporate finance* (4th ed.). Wiley.
4. Brigham, E. F., & Ehrhardt, M. C. (2020). *Financial management: Theory and practice* (16th ed.). Cengage Learning.
5. Pandey, I. M. (2021). *Financial management* (13th ed.). Vikas Publishing.

Reference Books

1. Van Horne, J. C., & Wachowicz, J. M. (2019). *Fundamentals of financial management* (15th ed.). Pearson.
2. Koller, T., Goedhart, M., & Wessels, D. (2020). *Valuation* (7th ed.). Wiley.
3. Berk, J., & DeMarzo, P. (2020). *Corporate finance* (5th ed.). Pearson.
4. Fabozzi, F. J., & Drake, P. P. (2019). *Finance: Capital markets, financial management* (3rd ed.). Wiley.
5. Graham, J. R., & Smart, S. B. (2021). *Introduction to corporate finance* (6th ed.). Cengage Learning.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Operations & Supply Chain Management

Course Category: Management Foundations
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand operations management concepts and systems
2. Analyze process design and capacity decisions
3. Apply inventory and supply chain models
4. Evaluate quality and productivity techniques
5. Integrate operations strategy with organizational goals

Course Outcomes

- CO1: Apply operations management principles
- CO2: Analyze process and capacity decisions
- CO3: Evaluate inventory and supply chain systems
- CO4: Apply quality and productivity tools
- CO5: Integrate operations strategy with business strategy

Detailed Syllabus

Unit I
Operations management scope; transformation systems; manufacturing and service operations; operations strategy alignment; competitiveness dimensions; process selection; productivity concepts; operational performance measures; strategic role of operations.

Unit II
Process design; process mapping; capacity planning; facility location factors; layout types; work measurement; line balancing; bottleneck analysis; operational efficiency improvement techniques.

Unit III
Demand forecasting methods; qualitative and quantitative forecasting; aggregate planning strategies; master production scheduling; material requirements planning basics; capacity requirements planning; operations planning integration.

Unit IV
Inventory management concepts; EOQ models; safety stock determination; ABC analysis; just-in-time systems; lean operations principles; waste elimination; continuous improvement practices.

Unit V
Supply chain management concepts; supply chain design; sourcing strategies; logistics management; distribution networks; supplier relationship management; performance measurement; risk and resilience in supply chains.

Text Books

1. Heizer, J., Render, B., & Munson, C. (2020). *Operations management* (13th ed.). Pearson.
2. Stevenson, W. J. (2021). *Operations management* (14th ed.). McGraw-Hill Education.
3. Slack, N., Brandon-Jones, A., & Burgess, N. (2022). *Operations management* (10th ed.). Pearson.
4. Krajewski, L. J., Malhotra, M. K., & Ritzman, L. P. (2019). *Operations management* (12th ed.). Pearson.
5. Chase, R. B., Aquilano, N. J., & Jacobs, F. R. (2020). *Operations management for competitive advantage*. McGraw-Hill Education.

Reference Books

1. Chopra, S., & Meindl, P. (2020). *Supply chain management* (7th ed.). Pearson.
2. Vollmann, T. E., Berry, W. L., Whybark, D. C., & Jacobs, F. R. (2018). *Manufacturing planning and control*. McGraw-Hill Education.
3. Goldratt, E. M. (2017). *The goal*. Routledge.

4. Waters, D. (2019). *Supply chain management*. Palgrave Macmillan.
5. Russel, R. S., & Taylor, B. W. (2020). *Operations management* (9th ed.). Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Management Information Systems & Analytics

Course Category: Quantitative Methods & Analytics
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand MIS concepts and organizational role
2. Analyze information systems for managerial decision making
3. Apply data analytics fundamentals
4. Evaluate enterprise information systems
5. Integrate digital technologies with business processes

Course Outcomes

- CO1: Explain MIS components and functions
- CO2: Analyze information systems for management support
- CO3: Apply basic analytics concepts
- CO4: Evaluate enterprise systems and digital platforms
- CO5: Integrate MIS with organizational strategy

Detailed Syllabus

Unit I
Information systems concepts; data, information, knowledge; MIS structure; transaction processing systems; decision support systems; executive information systems; managerial roles supported by MIS.

Unit II
Information systems development; systems analysis; systems design basics; database management concepts; data modeling; data warehousing; data governance; information quality management.

Unit III
Business analytics overview; descriptive, predictive, prescriptive analytics; data visualization concepts; dashboards; performance analytics; managerial interpretation of analytical outputs.

Unit IV
Enterprise systems; ERP concepts; CRM systems; SCM systems; integration benefits; implementation challenges; cloud computing fundamentals; platform-based business models.

Unit V
Digital transformation; big data concepts; business intelligence; cybersecurity basics; ethical and legal issues in information systems; emerging trends in MIS and analytics.

Text Books

1. Laudon, K. C., & Laudon, J. P. (2020). *Management information systems* (16th ed.). Pearson.
2. O'Brien, J. A., & Marakas, G. M. (2019). *Management information systems* (11th ed.). McGraw-Hill Education.
3. McLeod, R., & Schell, G. (2018). *Management information systems* (14th ed.). Pearson.
4. Sharda, R., Delen, D., & Turban, E. (2020). *Business intelligence, analytics, and data science* (4th ed.). Pearson.
5. Baltzan, P. (2021). *Business driven information systems* (8th ed.). McGraw-Hill Education.

Reference Books

1. Turban, E., Volonino, L., Wood, G. R., & Sipior, J. C. (2018). *Information technology for management*. Wiley.
2. Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). *MIS Quarterly*, 36(4), 1165–1188.
3. Davenport, T. H. (2014). *Big data at work*. Harvard Business Review Press.
4. Provost, F., & Fawcett, T. (2019). *Data science for business* (2nd ed.). O'Reilly Media.
5. Pearlson, K. E., Saunders, C. S., & Galletta, D. F. (2020). *Managing and using information systems* (7th ed.). Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Entrepreneurship & Venture Development

Course Category: Entrepreneurship, Failure Analytics & Case Research
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand entrepreneurial processes and ecosystems
2. Analyze opportunity identification and evaluation
3. Develop venture planning competencies
4. Evaluate financing and growth strategies
5. Integrate risk, ethics, and sustainability in ventures

Course Outcomes

- CO1: Identify and evaluate entrepreneurial opportunities
- CO2: Develop venture concepts and business models
- CO3: Analyze financing and growth options
- CO4: Assess entrepreneurial risks and ethics
- CO5: Apply entrepreneurial thinking in organizations

Detailed Syllabus

Unit I
Entrepreneurship concepts; entrepreneurial mindset; opportunity recognition; innovation sources; creativity techniques; entrepreneurial ecosystems; start-up typologies; socio-economic impact of entrepreneurship.

Unit II
Opportunity evaluation; feasibility analysis; market assessment; customer discovery; value proposition design; business model frameworks; competitive advantage in new ventures.

Unit III
Venture planning; business plan components; resource planning; team formation; legal forms of organization; intellectual property basics; operational planning.

Unit IV
Entrepreneurial finance; bootstrapping; angel investment; venture capital; funding stages; valuation basics; financial projections; investor expectations.

Unit V
Growth strategies; scaling challenges; strategic partnerships; risk management; ethical issues; sustainability orientation; exit strategies; contemporary entrepreneurship trends.

Text Books

1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2020). *Entrepreneurship* (10th ed.). McGraw-Hill Education.
2. Kuratko, D. F. (2020). *Entrepreneurship: Theory, process, practice* (11th ed.). Cengage Learning.
3. Barringer, B. R., & Ireland, R. D. (2021). *Entrepreneurship* (6th ed.). Pearson.
4. Scarborough, N. M., & Cornwall, J. R. (2019). *Essentials of entrepreneurship and small business management* (9th ed.). Pearson.
5. Timmons, J. A., & Spinelli, S. (2018). *New venture creation* (10th ed.). McGraw-Hill Education.

Reference Books

1. Drucker, P. F. (2015). *Innovation and entrepreneurship*. HarperBusiness.
2. Ries, E. (2017). *The lean startup*. Crown Business.
3. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.
4. Blank, S. (2013). *The four steps to the epiphany*. K&S Ranch.
5. Aulet, B. (2017). *Disciplined entrepreneurship*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation Management

Course Category: Entrepreneurship, Failure Analytics & Case Research
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop human-centered innovation capabilities
2. Apply design thinking frameworks
3. Foster creativity and problem-solving skills
4. Integrate innovation with organizational strategy
5. Manage innovation processes effectively

Course Outcomes

- CO1: Apply design thinking principles
- CO2: Generate innovative solutions
- CO3: Prototype and test ideas

- CO4: Integrate innovation with strategy
- CO5: Manage organizational innovation initiatives

Detailed Syllabus

Unit I
Design thinking concepts; human-centered design; empathy mapping; problem framing; design challenges; innovation contexts; role of creativity in management.

Unit II
Ideation techniques; brainstorming; lateral thinking; concept development; creativity tools; divergent and convergent thinking processes.

Unit III
Prototyping methods; low-fidelity prototypes; rapid experimentation; user feedback collection; iteration cycles; learning loops.

Unit IV
Innovation management; innovation types; incremental and radical innovation; organizational culture for innovation; leadership role in innovation.

Unit V
Design thinking applications; service design; business model innovation; innovation metrics; sustainability-driven innovation; contemporary innovation cases.

Text Books

1. Brown, T. (2009). *Change by design*. HarperBusiness.
2. Liedtka, J., King, A., & Bennett, K. (2017). *Solving problems with design thinking*. Columbia University Press.
3. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown Business.
4. Verganti, R. (2016). *Overcrowded*. MIT Press.
5. Martin, R. L. (2009). *The design of business*. Harvard Business Press.

Reference Books

1. Plattner, H., Meinel, C., & Leifer, L. (2011). *Design thinking*. Springer.
2. IDEO.org. (2015). *The field guide to human-centered design*. IDEO.
3. Christensen, C. M. (2016). *The innovator's dilemma*. Harvard Business Review Press.
4. Tidd, J., & Bessant, J. (2020). *Managing innovation* (6th ed.). Wiley.
5. Norman, D. A. (2013). *The design of everyday things*. Basic Books.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide practical industry exposure
2. Apply management concepts in real settings
3. Develop professional and ethical conduct
4. Enhance analytical and reporting skills
5. Prepare for advanced industry engagement

Course Outcomes

- CO1: Demonstrate professional workplace behavior
- CO2: Apply theoretical knowledge practically
- CO3: Analyze organizational processes
- CO4: Prepare structured internship reports
- CO5: Reflect on experiential learning

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER III

Start-up Failure Analytics & Diagnostic Models

Course Category: Entrepreneurship, Failure Analytics & Case Research
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Analyze structural and strategic causes of start-up failure
2. Apply diagnostic models to assess venture viability
3. Evaluate financial and operational distress indicators
4. Examine industry, market, and founder-related failure patterns
5. Develop analytical frameworks for failure prevention and recovery

Course Outcomes

- CO1: Identify multidimensional causes of start-up failure
- CO2: Apply diagnostic and analytical failure models
- CO3: Evaluate financial distress and performance signals
- CO4: Analyze market, strategy, and execution gaps
- CO5: Recommend evidence-based corrective interventions

Detailed Syllabus

Unit I
Start-up lifecycle stages; definitions and typologies of failure; survival versus failure metrics; global and Indian start-up failure statistics; entrepreneurial ecosystems influence; industry-specific failure patterns; macroeconomic sensitivity; innovation risk; venture mortality frameworks.

Unit II
Diagnostic models for failure analysis; business model stress testing; value proposition gaps; customer acquisition failures; unit economics assessment; scalability constraints; technology-product misfit; competitive dynamics; early warning signals; analytical dashboards.

Unit III
Financial failure analytics; cash burn analysis; runway estimation; liquidity, solvency ratios; revenue volatility; cost structure rigidity; funding gaps; investor expectations mismatch; financial statement red flags; forensic accounting perspectives.

Unit IV
Operational and governance failures; founder conflicts; leadership gaps; team capability

erosion; process inefficiencies; execution risks; regulatory non-compliance; ethical lapses; board oversight weaknesses; stakeholder misalignment; organizational culture issues.

Unit V
Failure prediction and prevention frameworks; turnaround diagnostics; pivot strategies; restructuring options; learning from failure cases; post-mortem analysis techniques; resilience building; risk mitigation systems; sustainable venture design; policy and ecosystem interventions.

Text Books

1. Ries, E. (2017). *The lean startup*. Crown Business.
2. Blank, S., & Dorf, B. (2020). *The startup owner's manual* (2nd ed.). Wiley.
3. Damodaran, A. (2012). *Investment valuation* (3rd ed.). Wiley.
4. Shepherd, D. A. (2019). *Entrepreneurial failure*. Cambridge University Press.
5. Mullins, J. W. (2023). *The customer-funded business* (2nd ed.). Wiley.

Reference Books

1. Croll, A., & Yoskovitz, B. (2013). *Lean analytics*. O'Reilly Media.
2. McGrath, R. G. (2013). *The end of competitive advantage*. Harvard Business Review Press.
3. Argenti, J. (2016). *Corporate collapse*. McGraw-Hill Education.
4. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.
5. Eisenmann, T. (2021). *Why startups fail*. Currency.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Case Research Methods & Qualitative Analysis

Course Category: Entrepreneurship, Failure Analytics & Case Research
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop rigorous case research design skills
2. Apply qualitative research methodologies
3. Analyze entrepreneurial and failure-oriented cases
4. Ensure validity, reliability, and ethical compliance

5. Produce publishable-quality case research outputs

Course Outcomes

- CO1: Design qualitative case research frameworks
- CO2: Apply data collection and coding techniques
- CO3: Analyze cases using thematic approaches
- CO4: Ensure research rigor and ethical standards
- CO5: Prepare structured academic case reports

Detailed Syllabus

Unit I
Case research philosophy; qualitative research paradigms; exploratory, explanatory case designs; single and multiple case approaches; research questions formulation; contextualization of start-up failure studies; theory-building objectives.

Unit II
Case selection strategies; sampling logic; data sources, interviews, observations, documents; protocol development; triangulation techniques; fieldwork planning; access negotiation; researcher reflexivity; ethical considerations.

Unit III
Qualitative data management; transcription standards; coding processes; open, axial, selective coding; thematic analysis; pattern matching; narrative analysis; use of qualitative analysis software; reliability checks.

Unit IV
Theory building from cases; cross-case synthesis; explanation building; rival explanations; validity, construct, internal, external; reliability enhancement; analytical generalization; methodological rigor in entrepreneurship research.

Unit V
Case writing structure; teaching versus research cases; failure case articulation; anonymization; peer review processes; publication outlets; impact assessment; academic integrity; dissemination of qualitative research findings.

Text Books

1. Yin, R. K. (2018). *Case study research and applications* (6th ed.). Sage.
2. Eisenhardt, K. M., & Graebner, M. E. (2007). *Academy of Management Journal*, 50(1), 25–32.
3. Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design* (4th ed.). Sage.
4. Stake, R. E. (1995). *The art of case study research*. Sage.

5. Miles, M. B., Huberman, A. M., & Saldaña, J. (2020). *Qualitative data analysis* (4th ed.). Sage.

Reference Books

1. Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). Sage.
2. Saldaña, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Sage.
3. Flyvbjerg, B. (2011). *Case study*. Sage.
4. Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). Sage.
5. Eisenhardt, K. M. (1989). *Academy of Management Review*, 14(4), 532–550.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Risk Management & Business Sustainability

Course Category: Management Foundations
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand enterprise risk management concepts and frameworks
2. Identify and classify business risks in dynamic environments
3. Apply risk assessment and mitigation tools
4. Integrate sustainability and resilience perspectives
5. Align risk management with strategic objectives

Course Outcomes

- CO1: Identify and classify business risks
- CO2: Apply risk assessment methodologies
- CO3: Evaluate risk mitigation strategies
- CO4: Integrate sustainability into risk decisions
- CO5: Align risk management with organizational strategy

Detailed Syllabus

Unit I
Risk management concepts, objectives, scope; uncertainty versus risk; enterprise risk management framework; strategic, operational, financial, compliance risks; internal and external risk sources; risk appetite, tolerance; governance structures; managerial relevance.

Unit II
Risk identification techniques; risk registers; qualitative risk assessment; quantitative risk assessment; probability-impact analysis; risk matrices; scenario analysis; sensitivity analysis; stress testing; early warning indicators.

Unit III
Risk mitigation strategies; risk avoidance, reduction, transfer, acceptance; insurance mechanisms; hedging concepts; diversification strategies; internal controls; business continuity planning; crisis preparedness; resilience building approaches.

Unit IV
Sustainability concepts; triple bottom line; environmental, social, governance risks; climate-related risks; sustainability reporting standards; stakeholder risk perspectives; sustainable value creation; regulatory expectations; long-term risk implications.

Unit V
Integrated risk management; strategic risk alignment; risk-adjusted performance measures; risk culture; technology-enabled risk management; analytics in risk monitoring; emerging risks; global risk trends; managerial decision implications.

Text Books

1. Hopkin, P. (2018). *Fundamentals of risk management* (4th ed.). Kogan Page.
2. Damodaran, A. (2008). *Strategic risk taking*. Wharton School Publishing.
3. Lam, J. (2014). *Enterprise risk management*. Wiley.
4. Rejda, G. E., & McNamara, M. J. (2020). *Principles of risk management and insurance* (14th ed.). Pearson.
5. Fraser, J., & Simkins, B. (2016). *Enterprise risk management*. Wiley.

Reference Books

1. Bernstein, P. L. (1996). *Against the gods*. Wiley.
2. Power, M. (2007). *Organized uncertainty*. Oxford University Press.
3. COSO. (2017). *Enterprise risk management—Integrating with strategy and performance*. COSO.
4. Kaplan, R. S., & Mikes, A. (2012). *Harvard Business Review*, 90(6), 48–60.
5. Taleb, N. N. (2012). *Antifragile*. Random House.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Legal, Regulatory & Governance Issues in Start-ups

Course Category: Management Foundations
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand legal environment affecting start-ups
2. Analyze regulatory frameworks and compliance requirements
3. Examine corporate governance principles
4. Assess legal risks and ethical obligations
5. Apply legal knowledge to start-up decision making

Course Outcomes

- CO1: Identify legal frameworks governing start-ups
- CO2: Analyze regulatory and compliance requirements
- CO3: Apply corporate governance principles
- CO4: Evaluate legal and ethical risks
- CO5: Integrate legal considerations into strategy

Detailed Syllabus

Unit I
Legal environment of business; sources of business law; contract law fundamentals; essential elements of valid contracts; performance, breach, remedies; relevance to start-up agreements; managerial legal awareness.

Unit II
Company law overview; incorporation procedures; types of business entities; shareholder rights; directors duties; board structures; statutory compliances; disclosure requirements; start-up legal structuring considerations.

Unit III
Regulatory frameworks for start-ups; labour laws applicability; taxation basics; GST overview; foreign exchange regulations; intellectual property rights fundamentals; patents, trademarks, copyrights; compliance risks.

Unit IV
Corporate governance principles; transparency, accountability, fairness; governance codes; role of independent directors; board committees; risk governance; ethical decision making; governance failures in start-ups.

Unit V
Legal issues in failure and exit; insolvency and bankruptcy overview; liquidation processes;

dispute resolution mechanisms; arbitration, mediation; legal aspects of mergers, acquisitions; regulatory lessons from start-up failures.

Text Books

1. Singh, A. (2020). *Business law* (10th ed.). Eastern Book Company.
2. Kuchhal, M. C., & Kuchhal, V. (2019). *Business law*. Vikas Publishing.
3. Avtar Singh. (2021). *Company law* (18th ed.). Eastern Book Company.
4. Pandey, J. N. (2018). *Legal aspects of business*. Central Law Agency.
5. Gower, L. C. B., & Davies, P. (2019). *Principles of modern company law* (10th ed.). Sweet & Maxwell.

Reference Books

1. Sehgal, A. (2018). *Corporate governance*. McGraw-Hill Education.
2. Tricker, B. (2019). *Corporate governance* (4th ed.). Oxford University Press.
3. OECD. (2015). *Principles of corporate governance*. OECD Publishing.
4. Ramaiya, A. (2020). *Guide to the Companies Act*. LexisNexis.
5. Iyer, V. (2019). *Legal environment of business*. Oxford University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective – Turnaround Strategies / Crisis Management

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand causes and stages of business decline
2. Analyze turnaround and crisis management frameworks
3. Evaluate restructuring and recovery strategies
4. Apply leadership approaches in crisis situations
5. Develop strategic response capabilities

Course Outcomes

- CO1: Diagnose business decline and crisis situations
- CO2: Apply turnaround strategy frameworks

- CO3: Evaluate restructuring and recovery options
- CO4: Assess leadership roles during crises
- CO5: Formulate effective crisis response plans

Detailed Syllabus

Unit I
Business decline concepts; early warning signals; internal and external causes of decline; industry downturns; strategic misalignment; financial distress indicators; operational inefficiencies; lifecycle perspective of failure.

Unit II
Turnaround management process; retrenchment strategies; asset reduction; cost restructuring; revenue stabilization; cash flow management; stakeholder communication; short-term survival priorities.

Unit III
Business restructuring strategies; operational restructuring; financial restructuring; debt renegotiation; organizational restructuring; leadership replacement; cultural renewal; governance interventions.

Unit IV
Crisis management concepts; types of crises; crisis preparedness; crisis response planning; communication strategies; media management; decision making under pressure; ethical challenges during crises.

Unit V
Recovery and growth post-crisis; strategic renewal; learning from failure; resilience building; turnaround success factors; global turnaround cases; contemporary crisis management challenges.

Text Books

1. Slatter, S., Lovett, D., & Barlow, L. (2011). *Leading corporate turnaround*. Wiley.
2. Bibeault, D. B. (2018). *Corporate turnaround*. Beard Books.
3. Fink, S. (2013). *Crisis management*. American Management Association.
4. Mitroff, I. I. (2005). *Why some companies emerge stronger*. AMACOM.
5. Pandit, N. R. (2000). *Turnaround strategies*. Oxford University Press.

Reference Books

1. Hambrick, D. C., & Schecter, S. M. (1983). *Strategic Management Journal*, 4(3), 231–242.
2. Sudarsanam, S. (2001). *Corporate financial distress and turnaround*. Wiley.

3. Pearson, C. M., & Clair, J. A. (1998). *Academy of Management Review*, 23(1), 59–76.
4. Shrivastava, P. (1993). *Journal of Management*, 19(1), 23–54.
5. Argenti, J. (2016). *Corporate collapse*. McGraw-Hill Education.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project (Start-up Failure Case Study)

Course Category: Project Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Apply failure analytics to a real start-up case
2. Conduct structured data collection and analysis
3. Integrate theory with empirical evidence
4. Develop academic writing and presentation skills
5. Demonstrate independent analytical capability

Course Outcomes

- CO1: Identify and analyze start-up failure dimensions
- CO2: Apply diagnostic and research frameworks
- CO3: Produce structured case documentation
- CO4: Present analytical findings effectively
- CO5: Demonstrate research rigor and originality

Guidelines

- Individual or group project, faculty supervision
- Case identification, data collection, analysis, reporting

Evaluation Scheme

Continuous Assessment (100%)

Industry Internship / Consulting Practicum

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Engage in industry-based analytical assignments
2. Apply consulting and diagnostic skills
3. Develop professional ethics and communication
4. Gain exposure to failure, turnaround, or risk contexts
5. Integrate academic learning with industry practice

Course Outcomes

- CO1: Demonstrate professional consulting conduct
- CO2: Apply analytical tools in organizational settings
- CO3: Analyze real-world business challenges
- CO4: Prepare structured practicum reports
- CO5: Reflect on experiential learning outcomes

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER IV

Strategic Management & Business Recovery

Course Category: Management Foundations
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop strategic thinking for complex business environments
2. Analyze competitive and corporate-level strategies
3. Evaluate strategic failure and recovery contexts
4. Apply turnaround and restructuring frameworks
5. Integrate strategy with sustainability and long-term value creation

Course Outcomes

- CO1: Analyze internal and external strategic environments
- CO2: Evaluate competitive and corporate strategies
- CO3: Diagnose strategic causes of business failure
- CO4: Apply business recovery and turnaround strategies
- CO5: Formulate sustainable strategic solutions

Detailed Syllabus

Unit I
Strategic management concepts; vision, mission, objectives; strategic intent; external environment analysis, PESTLE framework; industry analysis, Porter forces; competitive advantage sources; strategic fit; strategy formulation process; ethical and governance considerations.

Unit II
Internal analysis; resources, capabilities, core competencies; value chain analysis; VRIO framework; strategic cost analysis; benchmarking; organizational strengths and weaknesses; strategic capability assessment; dynamic capabilities; strategic decision contexts.

Unit III
Business-level strategies; cost leadership, differentiation, focus; corporate-level strategies; diversification, integration; strategic alliances; mergers, acquisitions rationale; global strategies; strategic implementation challenges; structure-strategy alignment.

Unit IV
Strategic failure analysis; decline stages; turnaround situations; retrenchment, divestment

strategies; business restructuring; revival plans; leadership in crisis; stakeholder communication; strategic control systems; recovery performance indicators.

Unit V
Strategic evaluation and control; balanced scorecard; risk-adjusted strategy; sustainability integration; ESG considerations; corporate governance linkage; strategy in uncertain environments; digital disruption; contemporary strategic management issues.

Text Books

1. David, F. R., David, F. R., & David, M. E. (2020). *Strategic management* (17th ed.). Pearson.
2. Hill, C. W. L., Jones, G. R., & Schilling, M. A. (2021). *Strategic management* (13th ed.). Cengage Learning.
3. Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2020). *Strategic management* (13th ed.). Cengage Learning.
4. Grant, R. M. (2022). *Contemporary strategy analysis* (11th ed.). Wiley.
5. Thompson, A. A., Strickland, A. J., Gamble, J. E., & Peteraf, M. A. (2020). *Crafting and executing strategy* (22nd ed.). McGraw-Hill Education.

Reference Books

1. Porter, M. E. (2008). *Competitive strategy*. Free Press.
2. Rumelt, R. (2017). *Good strategy bad strategy*. Crown Business.
3. Johnson, G., Scholes, K., & Whittington, R. (2020). *Exploring strategy* (12th ed.). Pearson.
4. Barney, J. B., & Hesterly, W. (2021). *Strategic management and competitive advantage* (6th ed.). Pearson.
5. Wheelen, T. L., & Hunger, J. D. (2018). *Strategic management and business policy* (15th ed.). Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Behavioral Decision Making & Cognitive Biases

Course Category: Management Foundations
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand psychological foundations of managerial decisions
2. Analyze cognitive biases affecting judgment
3. Evaluate decision-making under risk and uncertainty
4. Apply behavioral insights to managerial contexts
5. Improve decision quality and organizational outcomes

Course Outcomes

- CO1: Explain behavioral decision-making concepts
- CO2: Identify cognitive biases in managerial contexts
- CO3: Analyze decision-making under uncertainty
- CO4: Apply debiasing techniques
- CO5: Enhance managerial judgment effectiveness

Detailed Syllabus

Unit I
Behavioral economics foundations; rationality assumptions; bounded rationality; heuristics; judgment processes; intuition versus analysis; decision environments; managerial relevance; behavioral perspectives in organizational decision making.

Unit II
Cognitive biases; availability, representativeness, anchoring; overconfidence bias; confirmation bias; framing effects; loss aversion; prospect theory; managerial implications; bias identification techniques.

Unit III
Decision making under risk; uncertainty contexts; probability judgment errors; risk perception; escalation of commitment; group decision biases; social influences; organizational decision traps.

Unit IV
Debiasing strategies; structured decision processes; checklists; analytical tools; scenario planning; behavioral interventions; nudges; choice architecture; ethical decision considerations.

Unit V
Behavioral decision making in strategy; investment decisions; entrepreneurial judgment;

policy implications; behavioral governance; digital decision environments; contemporary research directions.

Text Books

1. Bazerman, M. H., & Moore, D. A. (2017). *Judgment in managerial decision making* (8th ed.). Wiley.
2. Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.
3. Thaler, R. H., & Sunstein, C. R. (2021). *Nudge* (Revised ed.). Penguin.
4. Ariely, D. (2010). *Predictably irrational*. HarperCollins.
5. Hastie, R., & Dawes, R. M. (2019). *Rational choice in an uncertain world* (2nd ed.). Sage.

Reference Books

1. Gigerenzer, G. (2015). *Risk savvy*. Viking.
2. Tversky, A., & Kahneman, D. (1974). *Science*, 185(4157), 1124–1131.
3. Stanovich, K. E. (2018). *The bias that divides us*. MIT Press.
4. Milkman, K. L. (2021). *How to change*. Portfolio.
5. Hammond, J. S., Keeney, R. L., & Raiffa, H. (2015). *Smart choices*. Harvard Business Review Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Public Policy, Start-up Ecosystems & Institutions

Course Category: Communication, Ethics & Policy Studies
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand public policy frameworks influencing start-ups
2. Analyze start-up ecosystems and institutional support structures
3. Evaluate government initiatives and regulatory institutions
4. Assess policy impact on innovation and entrepreneurship
5. Integrate policy perspectives into strategic decision making

Course Outcomes

- CO1: Analyze public policy frameworks for entrepreneurship

- CO2: Evaluate start-up ecosystem components
- CO3: Assess institutional roles in venture development
- CO4: Interpret policy impacts on innovation outcomes
- CO5: Integrate policy considerations into business strategy

Detailed Syllabus

Unit I
Public policy concepts; policy formulation process; economic development policies; industrial policy evolution; role of state in entrepreneurship promotion; policy instruments; market failures; public-private interaction frameworks.

Unit II
Start-up ecosystems; ecosystem components; entrepreneurs, investors, incubators, accelerators; universities, research institutions; networks and clusters; regional ecosystems; global ecosystem comparisons; ecosystem performance indicators.

Unit III
Institutional frameworks; role of government agencies; regulatory bodies; financial institutions; development banks; venture capital institutions; incubation policies; technology transfer offices; institutional coordination mechanisms.

Unit IV
Indian start-up policy landscape; Start-up India initiative; MSME policies; innovation missions; digital public infrastructure; ease of doing business reforms; policy incentives; implementation challenges.

Unit V
Policy evaluation and impact assessment; policy gaps; inclusive entrepreneurship; sustainability-oriented policies; future policy directions; global best practices; policy learning from start-up failures.

Text Books

1. Audretsch, D. B. (2015). *Entrepreneurship and public policy*. Springer.
2. Isenberg, D. (2010). *Harvard Business Review*, 88(6), 40–50.
3. Mazzucato, M. (2018). *The entrepreneurial state*. Penguin.
4. Acs, Z. J., Autio, E., & Szerb, L. (2014). *Research Policy*, 43(3), 476–494.
5. Rodrik, D. (2007). *One economics, many recipes*. Princeton University Press.

Reference Books

1. World Bank. (2020). *Doing business report*. World Bank Publications.
2. OECD. (2019). *Entrepreneurship at a glance*. OECD Publishing.

3. Porter, M. E. (1998). *The competitive advantage of nations*. Free Press.
4. Saxenian, A. (1994). *Regional advantage*. Harvard University Press.
5. Feld, B. (2012). *Startup communities*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective – Data-Driven Strategy / Corporate Governance

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Apply data-driven approaches to strategic decision making
2. Understand corporate governance principles and structures
3. Analyze governance failures and strategic consequences
4. Integrate analytics with governance mechanisms
5. Enhance strategic control and accountability

Course Outcomes

- CO1: Apply data analytics in strategic contexts
- CO2: Analyze corporate governance frameworks
- CO3: Evaluate governance failures and risks
- CO4: Integrate data-driven insights with governance
- CO5: Strengthen strategic oversight mechanisms

Detailed Syllabus

Unit I
Data-driven strategy concepts; strategic analytics; data as strategic asset; analytics maturity models; evidence-based management; strategic decision support systems.

Unit II
Corporate governance concepts; governance models; board structures; ownership patterns; agency theory; stakeholder theory; governance mechanisms and controls.

Unit III
Analytics for governance; performance dashboards; risk analytics; compliance monitoring; early warning indicators; governance reporting systems.

Unit IV
Governance failures; case analysis of corporate collapses; board effectiveness issues; ethical lapses; regulatory responses; lessons for strategic governance.

Unit V
Future of governance; digital governance; AI and board decision making; ESG analytics; transparency technologies; integrated strategy and governance perspectives.

Text Books

1. Provost, F., & Fawcett, T. (2019). *Data science for business* (2nd ed.). O'Reilly Media.
2. Tricker, B. (2019). *Corporate governance* (4th ed.). Oxford University Press.
3. Davenport, T. H., & Harris, J. G. (2017). *Competing on analytics*. Harvard Business Review Press.
4. Monks, R. A. G., & Minow, N. (2018). *Corporate governance* (5th ed.). Wiley.
5. McAfee, A., & Brynjolfsson, E. (2017). *Machine, platform, crowd*. Norton.

Reference Books

1. Kaplan, R. S., & Norton, D. P. (2006). *Alignment*. Harvard Business School Press.
2. OECD. (2015). *Principles of corporate governance*. OECD Publishing.
3. Power, M. (2007). *Organized uncertainty*. Oxford University Press.
4. Brynjolfsson, E., & McElheran, K. (2016). *MIT Sloan Management Review*, 57(2), 33–38.
5. Solomon, J. (2020). *Corporate governance and accountability* (5th ed.). Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project Phase I (Applied Research / Industry Based)

Course Category: Project Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Identify applied research or industry problem
2. Conduct comprehensive literature review
3. Develop research design and methodology
4. Initiate data collection and preliminary analysis

5. Prepare structured interim project documentation

Course Outcomes

- CO1: Formulate applied research problem
- CO2: Design suitable research methodology
- CO3: Collect and organize research data
- CO4: Demonstrate analytical rigor
- CO5: Present interim research findings

Guidelines

- Problem identification, proposal submission
- Literature review, methodology finalization
- Interim report and presentation

Evaluation Scheme

Continuous Assessment (100%)

Major Project Phase II (Thesis / Case Portfolio)

Course Category: Project Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Complete applied research or case portfolio
2. Analyze data and synthesize findings
3. Develop managerial and policy implications
4. Demonstrate academic writing competence
5. Defend research outcomes

Course Outcomes

- CO1: Produce complete thesis or case portfolio
- CO2: Apply advanced analytical tools
- CO3: Integrate theory with empirical findings
- CO4: Present defensible conclusions
- CO5: Demonstrate originality and rigor

Guidelines

- Final report preparation
- Thesis submission and evaluation
- Oral defense as per institutional norms

Evaluation Scheme

Continuous Assessment (100%)

Seminar / Viva-Voce

Course Category: Seminar / Viva-Voce
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Assess comprehensive programme learning
2. Evaluate analytical and research competence
3. Test conceptual integration
4. Assess professional communication skills
5. Validate readiness for professional practice

Course Outcomes

- CO1: Demonstrate integrated programme knowledge
- CO2: Defend research and project work
- CO3: Exhibit analytical and critical thinking
- CO4: Communicate professionally
- CO5: Demonstrate industry and research readiness

Guidelines

- Seminar presentation
- Viva-voce examination by internal and external experts

Evaluation Scheme

Viva-Voce Examination (100%)

B.Com. – Digital Commerce & Financial Technologies

Duration: 3 Years | 6 SEMESTER s | Total Credits: 120

SEMESTER I

Business Mathematics & Statistics

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop quantitative aptitude for commercial and financial problem solving.
2. Build mathematical foundations required for business decision making.
3. Introduce statistical tools for data summarization and analysis.
4. Enable application of mathematics in economics and commerce contexts.
5. Strengthen logical reasoning and analytical accuracy.

Course Outcomes

- CO1: Apply mathematical techniques to business related problems.
- CO2: Analyze functions and relationships relevant to commerce.
- CO3: Use statistical measures for data interpretation.
- CO4: Solve probability based business situations.
- CO5: Interpret statistical results for managerial decisions.

Detailed Syllabus

Unit I:
Functions, types of functions, algebraic operations; limits, continuity concepts; simple applications in commerce; functional relationships in demand and supply; mathematical representation of economic variables; graphical interpretation, problem solving orientation.

Unit II:
Differentiation, rules of differentiation, higher order derivatives; maxima and minima; optimization in business decisions; cost, revenue, profit functions; elasticity of demand concepts; marginal analysis, graphical and numerical illustrations.

Unit III:
Integral calculus, standard forms; definite and indefinite integrals; applications in commerce;

consumer surplus, producer surplus; area under curves; simple economic applications; analytical interpretation, problem oriented exercises.

Unit IV:
Statistics fundamentals, data classification and tabulation; measures of central tendency, dispersion; mean, median, mode; variance, standard deviation; interpretation of business data; numerical problem solving emphasis.

Unit V:
Probability concepts, laws of probability; random variables; binomial distribution; applications in business risk analysis; decision making under uncertainty; numerical illustrations, commerce oriented problem contexts.

Text Books

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics* (12th ed.). Sultan Chand & Sons.
2. Dowling, E. T. (2019). *Mathematics for economics* (4th ed.). McGraw Hill Education.
3. Yamane, T. (2018). *Mathematics for economists*. PHI Learning.
4. Chiang, A. C., & Wainwright, K. (2017). *Fundamental methods of mathematical economics* (4th ed.). McGraw Hill.
5. Spiegel, M. R. (2018). *Theory and problems of statistics*. McGraw Hill.

Reference Books

1. Allen, R. G. D. (2016). *Mathematical analysis for economists*. Palgrave Macmillan.
2. Mehta, B. C., & Madnani, G. M. K. (2019). *Mathematics for economists*. Sultan Chand & Sons.
3. Levin, R. I., & Rubin, D. S. (2018). *Statistics for management*. Pearson Education.
4. Anderson, D. R., Sweeney, D. J., & Williams, T. A. (2019). *Statistics for business and economics*. Cengage Learning.
5. Hogg, R. V., & Craig, A. T. (2017). *Introduction to mathematical statistics*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Principles of Accounting

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Introduce basic accounting concepts and principles.
2. Develop skills in recording business transactions.
3. Enable preparation of financial statements.
4. Build understanding of accounting standards.
5. Support financial literacy for commerce students.

Course Outcomes

- CO1: Understand accounting concepts and conventions.
- CO2: Record transactions using double entry system.
- CO3: Prepare trial balance and final accounts.
- CO4: Interpret financial statements.
- CO5: Apply accounting principles in business contexts.

Detailed Syllabus

Unit I:
Accounting concepts, conventions, principles; accounting standards overview; objectives and functions of accounting; users of accounting information; business transactions; accounting equation; role of accounting in commerce organizations.

Unit II:
Double entry system; journalizing transactions; ledger posting; balancing of accounts; subsidiary books; cash book, purchase book, sales book; accounting cycle; numerical illustrations and practical orientation.

Unit III:
Trial balance preparation; errors and rectification; suspense account; classification of errors; accounting treatment; practical problem solving; accuracy verification in accounting records.

Unit IV:
Final accounts of sole proprietorship; trading account, profit and loss account; balance sheet preparation; adjustments; depreciation; outstanding expenses; accrued incomes; practical illustrations.

Unit V:
Introduction to accounting standards; concept of capital and revenue; reserves and provisions;

accounting ethics; limitations of accounting; contemporary issues; financial information interpretation.

Text Books

1. Grewal, T. S. (2021). *Introduction to accounting*. Sultan Chand & Sons.
2. Gupta, R. L., & Radhaswamy, M. (2020). *Financial accounting*. Sultan Chand & Sons.
3. Jain, S. P., & Narang, K. L. (2019). *Advanced accounting*. Kalyani Publishers.
4. Anthony, R. N., & Reece, J. S. (2018). *Accounting principles*. Irwin.
5. Wood, F., & Sangster, A. (2019). *Business accounting*. Pearson.

Reference Books

1. Meigs, R. F., Williams, J. R., & Haka, S. (2018). *Financial accounting*. McGraw Hill.
2. Libby, R., Libby, P., & Short, D. (2019). *Financial accounting*. McGraw Hill.
3. Lal, J. (2020). *Accounting theory*. Tata McGraw Hill.
4. Needles, B. E., & Powers, M. (2017). *Principles of accounting*. Cengage.
5. Stickney, C. P., & Weil, R. L. (2018). *Financial accounting*. South-Western.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Microeconomics for Business

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Build foundational understanding of microeconomic principles.
2. Analyze consumer and producer behavior in markets.
3. Examine cost and production relationships.
4. Understand pricing and market structures.
5. Apply microeconomic reasoning to business decisions.

Course Outcomes

- CO1: Interpret microeconomic concepts in business contexts.
- CO2: Analyze demand and supply behavior.

- CO3: Evaluate production and cost relationships.
- CO4: Assess pricing decisions under different markets.
- CO5: Apply microeconomic tools for managerial decision making.

Detailed Syllabus

Unit I:
Microeconomics meaning, scope, importance; economic models, assumptions; scarcity, choice, opportunity cost; demand concepts; demand determinants; individual and market demand; relevance of microeconomic analysis for business decision environments.

Unit II:
Elasticity of demand concepts; price, income, cross elasticity; measurement methods; factors influencing elasticity; business applications; pricing decisions; revenue implications; numerical illustrations for managerial interpretation.

Unit III:
Production concepts; short run and long run production; law of variable proportions; returns to scale; isoquants; producer equilibrium; production efficiency; relevance for capacity planning and operational decisions.

Unit IV:
Cost concepts; fixed and variable costs; short run and long run cost curves; cost output relationships; economies and diseconomies of scale; cost control implications for business organizations.

Unit V:
Market structures overview; perfect competition, monopoly, monopolistic competition, oligopoly; price and output determination; business strategy implications; comparative analysis of market forms.

Text Books

1. Koutsoyiannis, A. (2018). *Modern microeconomics*. Palgrave Macmillan.
2. Pindyck, R. S., & Rubinfeld, D. L. (2020). *Microeconomics*. Pearson.
3. Salvatore, D. (2019). *Managerial economics*. Oxford University Press.
4. Mankiw, N. G. (2021). *Principles of economics*. Cengage Learning.
5. Dwivedi, D. N. (2020). *Microeconomics*. Vikas Publishing.

Reference Books

1. Lipsey, R. G., & Chrystal, K. A. (2018). *Economics*. Oxford University Press.
2. Case, K. E., Fair, R. C., & Oster, S. (2019). *Principles of economics*. Pearson.
3. Samuelson, P. A., & Nordhaus, W. D. (2019). *Economics*. McGraw Hill.

4. Ferguson, C. E., & Gould, J. P. (2017). *Microeconomic theory*. Richard D. Irwin.
5. Varian, H. R. (2019). *Intermediate microeconomics*. W. W. Norton.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Fundamentals of Commerce & Trade

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamentals of commerce and trade systems.
2. Understand internal and external trade mechanisms.
3. Examine trade institutions and auxiliaries.
4. Analyze role of commerce in economic development.
5. Build foundation for advanced commerce studies.

Course Outcomes

- CO1: Explain scope and importance of commerce.
- CO2: Distinguish trade types and structures.
- CO3: Analyze trade auxiliaries and institutions.
- CO4: Understand commerce related business practices.
- CO5: Relate commerce activities to economic growth.

Detailed Syllabus

Unit I:
Commerce meaning, nature, scope; evolution of commerce; relationship with industry; components of commerce; trade and aids to trade; role of commerce in modern economic systems.

Unit II:
Trade concepts; internal trade, external trade; wholesale and retail trade; functions of wholesalers and retailers; modern retail formats; trade practices in domestic markets.

Unit III:
Auxiliaries to trade; transport systems; warehousing; insurance services; banking role; communication systems; facilitation of smooth exchange of goods and services.

Unit IV:
Trade institutions; chambers of commerce; trade associations; cooperative institutions; role in business promotion; regulation of trade practices; institutional support mechanisms.

Unit V:
Commerce and economic development; globalization impact; digital transformation of trade; emerging trends; challenges in commerce; relevance for contemporary business environments.

Text Books

1. Gupta, C. B. (2020). *Business studies*. Sultan Chand & Sons.
2. Pillai, R. S. N., & Bagavathi. (2019). *Modern commercial studies*. S. Chand.
3. Kaur, G. (2018). *Fundamentals of commerce*. Kalyani Publishers.
4. Sharma, R. K. (2019). *Business organization and management*. Kalyani.
5. Varshney, R. L. (2018). *Business organization*. Sultan Chand.

Reference Books

1. Koontz, H., & Weihrich, H. (2018). *Essentials of management*. McGraw Hill.
2. Drucker, P. F. (2017). *Management*. Harper Business.
3. Boone, L. E., & Kurtz, D. L. (2019). *Contemporary business*. Wiley.
4. Cherunilam, F. (2018). *Business environment*. Himalaya Publishing.
5. Francis, J. (2019). *Business studies*. Oxford University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Literacy & Office Automation

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop foundational digital literacy skills.
2. Build proficiency in office automation tools.
3. Enable effective digital communication and documentation.
4. Promote safe and ethical digital practices.
5. Support technology enabled academic and business work.

Course Outcomes

- CO1: Use computer systems and operating environments.
- CO2: Apply word processing and spreadsheet tools.
- CO3: Prepare digital presentations and documents.
- CO4: Utilize internet and email services effectively.
- CO5: Practice responsible digital behavior.

Detailed Syllabus

Unit I:
Computer fundamentals; hardware and software components; operating systems overview; file management; input output devices; computing concepts; role of digital literacy in commerce and business operations.

Unit II:
Word processing tools; document creation, formatting; tables, templates; business correspondence preparation; report writing; document sharing; productivity enhancement through automation tools.

Unit III:
Spreadsheet applications; worksheet management; formulas, functions; data analysis basics; charts and graphs; financial and business data handling using spreadsheet tools.

Unit IV:
Presentation software; slide design principles; multimedia integration; professional presentation techniques; communication effectiveness; academic and business presentation requirements.

Unit V:
Internet fundamentals; email communication; online collaboration tools; digital safety, cyber ethics; data privacy awareness; responsible use of digital technologies.

Text Books

1. Norton, P. (2019). *Introduction to computers*. McGraw Hill.
2. Shelly, G. B., & Vermaat, M. E. (2018). *Discovering computers*. Cengage.
3. Rajaraman, V. (2019). *Fundamentals of computers*. PHI Learning.
4. Lambert, J. (2020). *Microsoft Office 365*. Microsoft Press.
5. Sinha, P. K. (2018). *Computer fundamentals*. BPB Publications.

Reference Books

1. Laudon, K. C., & Laudon, J. P. (2019). *Management information systems*. Pearson.

2. Turban, E., et al. (2018). *Information technology for management*. Wiley.
3. O'Leary, T. J. (2019). *Computing essentials*. McGraw Hill.
4. Morley, D., & Parker, C. (2018). *Understanding computers*. Cengage.
5. Negus, C. (2019). *Linux Bible*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Business Communication & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop foundational proficiency in professional English usage.
2. Enhance business oriented written communication skills.
3. Strengthen oral communication for workplace contexts.
4. Build confidence in interpersonal and group communication.
5. Support employability through effective professional language skills.

Course Outcomes

- CO1: Use professional English in business environments.
- CO2: Prepare structured business documents.
- CO3: Demonstrate effective oral communication skills.
- CO4: Apply communication strategies in organizational settings.
- CO5: Exhibit confidence in professional interactions.

Detailed Syllabus

Unit I:
Communication concepts, process, elements; verbal and non verbal communication; barriers to communication; business communication significance; formal and informal communication channels; organizational communication flow; clarity, accuracy, appropriateness in professional contexts.

Unit II:
Business vocabulary development; functional grammar usage; sentence structure accuracy; common business expressions; tone and style in professional writing; avoidance of ambiguity; language precision for commercial and organizational communication needs.

Unit III:
Business correspondence formats; letters, emails, memoranda; report writing basics; structure and layout; coherence and cohesion; summaries and notices; documentation standards; professional etiquette in written business communication practices.

Unit IV:
Oral communication skills; presentations structure; public speaking techniques; voice modulation, articulation; body language awareness; listening skills; group discussions; meetings participation; confidence building in professional speaking situations.

Unit V:
Interpersonal communication skills; workplace conversations; interview skills; resume and cover letter preparation; negotiation basics; cross cultural communication awareness; ethical communication practices; employability focused professional language competence.

Text Books

1. Bovee, C. L., & Thill, J. V. (2020). *Business communication today* (14th ed.). Pearson Education.
2. Lesikar, R. V., Flatley, M. E., Rentz, K., & Lentz, P. (2019). *Business communication: Making connections in a digital world*. McGraw Hill.
3. Raman, M., & Sharma, S. (2021). *Technical communication: Principles and practice*. Oxford University Press.
4. Murphy, R. (2019). *English grammar in use* (5th ed.). Cambridge University Press.
5. Guffey, M. E., & Loewy, D. (2021). *Essentials of business communication*. Cengage Learning.

Reference Books

1. Chaney, L. H., & Martin, J. S. (2018). *Intercultural business communication*. Pearson.
2. McLean, S. (2019). *Business communication for success*. Open Textbook Library.
3. Eastwood, J. (2018). *Oxford practice grammar*. Oxford University Press.
4. Taylor, S. (2020). *Communication for business*. Pearson Education.
5. Mitra, B. K. (2017). *Personality development and soft skills*. Oxford University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Field Orientation / Industry Exposure

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to real business environments.
2. Develop industry awareness and professional orientation.
3. Relate classroom learning with practice.
4. Build observational and reporting skills.
5. Enhance career readiness.

Course Outcomes

- CO1: Observe organizational structures and operations.
- CO2: Identify functional business activities.
- CO3: Relate theory with practice.
- CO4: Prepare structured field reports.
- CO5: Demonstrate professional conduct.

Guidelines

Industry visit planning, interaction with professionals, observation of operations, documentation of learning, reflective reporting.

Evaluation Scheme

Field Report (60%) + Viva-Voce (40%)

SEMESTER II

Business Economics

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Provide economic reasoning tools for business analysis.
2. Develop understanding of macroeconomic environment.
3. Analyze demand, supply, and market equilibrium.
4. Examine national income and economic growth indicators.
5. Support managerial decision making through economic principles.

Course Outcomes

- CO1: Apply economic concepts to business situations.
- CO2: Analyze market forces affecting business decisions.
- CO3: Interpret macroeconomic indicators.
- CO4: Evaluate government policies impacting commerce.
- CO5: Integrate economic reasoning into managerial planning.

Detailed Syllabus

Unit I:
Economics meaning, scope, micro and macro economics; economic laws and assumptions; business economics relevance; scarcity, choice, opportunity cost; production possibility curve; economic problem analysis in business environments.

Unit II:
Demand concepts, law of demand, determinants; elasticity of demand, types, measurement methods; business applications; consumer behavior assumptions; demand forecasting significance; numerical illustrations, graphical interpretation.

Unit III:
Supply concepts, law of supply; market equilibrium; price determination under perfect competition; shifts in demand and supply; price mechanism; practical relevance for business pricing strategies.

Unit IV:
National income concepts; GDP, GNP, NDP, NNP; methods of national income estimation;

limitations; economic growth and development indicators; business implications of income changes.

Unit V:
Inflation meaning, causes, effects; business cycles phases; fiscal policy tools; monetary policy instruments; role of government in economic stabilization; impact on business operations.

Text Books

1. Samuelson, P. A., & Nordhaus, W. D. (2019). *Economics* (20th ed.). McGraw Hill.
2. Mankiw, N. G. (2021). *Principles of economics* (9th ed.). Cengage Learning.
3. Koutsoyiannis, A. (2018). *Modern microeconomics*. Palgrave Macmillan.
4. Dwivedi, D. N. (2020). *Managerial economics*. Vikas Publishing.
5. Varshney, R. L., & Maheshwari, K. L. (2019). *Managerial economics*. Sultan Chand.

Reference Books

1. Lipsey, R. G., & Chrystal, K. A. (2018). *Economics*. Oxford University Press.
2. Peterson, H. C., & Lewis, W. C. (2017). *Managerial economics*. Pearson.
3. Dornbusch, R., Fischer, S., & Startz, R. (2019). *Macroeconomics*. McGraw Hill.
4. Salvatore, D. (2018). *Managerial economics*. Oxford University Press.
5. Pindyck, R. S., & Rubinfeld, D. L. (2020). *Microeconomics*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Financial Accounting

Course Category: Accounting & Finance Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Strengthen financial accounting knowledge.
2. Develop skills in preparation of financial statements.
3. Introduce depreciation and inventory valuation.
4. Understand partnership accounting fundamentals.
5. Support financial reporting accuracy.

Course Outcomes

- CO1: Prepare financial statements accurately.
- CO2: Apply depreciation and inventory methods.
- CO3: Analyze partnership accounts.
- CO4: Interpret accounting information.
- CO5: Ensure compliance with accounting principles.

Detailed Syllabus

Unit I:
Accounting principles revision; accounting standards overview; financial accounting objectives; accounting cycle review; practical orientation; financial information users; relevance for business decision making.

Unit II:
Depreciation meaning, causes; straight line and written down value methods; accounting treatment; asset valuation; numerical illustrations; impact on profit measurement.

Unit III:
Inventory valuation meaning; FIFO, LIFO, weighted average methods; accounting standards relevance; stock valuation impact on profits; numerical illustrations; business implications.

Unit IV:
Partnership accounting fundamentals; admission of partner; goodwill treatment; capital adjustment; profit sharing ratios; practical problems; accounting accuracy emphasis.

Unit V:
Dissolution of partnership; realization account; settlement of accounts; accounting treatment; preparation of final statements; numerical illustrations; financial closure procedures.

Text Books

1. Gupta, R. L., & Radhaswamy, M. (2021). *Financial accounting*. Sultan Chand & Sons.
2. Jain, S. P., & Narang, K. L. (2020). *Advanced accounting*. Kalyani Publishers.
3. Grewal, T. S. (2022). *Double entry bookkeeping*. Sultan Chand & Sons.
4. Meigs, R. F., & Meigs, W. B. (2019). *Accounting*. McGraw Hill.
5. Wood, F., & Sangster, A. (2020). *Business accounting*. Pearson.

Reference Books

1. Libby, R., Libby, P., & Short, D. (2019). *Financial accounting*. McGraw Hill.
2. Stickney, C. P., & Weil, R. L. (2018). *Financial accounting*. South-Western.
3. Lal, J. (2020). *Accounting theory*. Tata McGraw Hill.

4. Anthony, R. N., & Reece, J. S. (2018). *Accounting principles*. Irwin.
5. Needles, B. E., & Powers, M. (2017). *Principles of accounting*. Cengage.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Principles of Management

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fundamental concepts of management.
2. Examine managerial functions and roles.
3. Analyze organizational structures and processes.
4. Develop leadership and motivation perspectives.
5. Build foundation for managerial decision making.

Course Outcomes

- CO1: Identify management principles and functions.
- CO2: Analyze planning and organizing processes.
- CO3: Evaluate leadership and motivation approaches.
- CO4: Understand control and coordination mechanisms.
- CO5: Apply management concepts to business situations.

Detailed Syllabus

Unit I:
Management meaning, nature, scope; evolution of management thought; scientific management, administrative theory; systems approach; functions of management; managerial roles; relevance of management in business organizations.

Unit II:
Planning concepts; objectives setting; policies, procedures; decision making process; forecasting techniques; strategic and operational planning; importance of planning for organizational effectiveness.

Unit III:
Organizing concepts; organizational structure types; authority, responsibility, accountability;

delegation and decentralization; span of control; organizational design for efficiency and coordination.

Unit IV:
Leadership concepts; leadership styles; motivation theories; Maslow, Herzberg, McGregor; communication process; directing functions; employee engagement and performance enhancement.

Unit V:
Controlling concepts; control techniques; budgetary control; standard costing; coordination importance; contemporary management challenges; managerial effectiveness in dynamic environments.

Text Books

1. Koontz, H., & Weihrich, H. (2019). *Essentials of management*. McGraw Hill.
2. Robbins, S. P., & Coulter, M. (2020). *Management*. Pearson.
3. Griffin, R. W. (2018). *Management*. Cengage Learning.
4. Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R. (2019). *Management*. Pearson.
5. Gupta, C. B. (2020). *Management theory and practice*. Sultan Chand.

Reference Books

1. Drucker, P. F. (2017). *Management*. Harper Business.
2. Fayol, H. (2016). *General and industrial management*. Martino.
3. Mintzberg, H. (2018). *Managing*. Berrett-Koehler.
4. Daft, R. L. (2019). *Management*. Cengage.
5. George, C. S. (2018). *History of management thought*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Introduction to E-Commerce

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamentals of electronic commerce.
2. Understand e commerce business models.
3. Examine digital transaction processes.

4. Analyze legal and security aspects of e commerce.
5. Build foundation for advanced digital commerce studies.

Course Outcomes

- CO1: Explain e commerce concepts and scope.
- CO2: Identify e commerce business models.
- CO3: Understand digital transaction workflows.
- CO4: Analyze legal and security issues.
- CO5: Apply e commerce concepts to business scenarios.

Detailed Syllabus

Unit I:
Electronic commerce meaning, scope; evolution of e commerce; traditional commerce versus e commerce; benefits and limitations; technological infrastructure; role of internet in digital business.

Unit II:
E commerce business models; B2B, B2C, C2C, C2B; marketplace models; revenue models; value chain in digital commerce; platform based business structures.

Unit III:
E commerce processes; online marketing; order processing; electronic payment systems overview; logistics and fulfillment; customer relationship management in e commerce.

Unit IV:
Legal aspects of e commerce; cyber laws; intellectual property rights; taxation issues; digital contracts; regulatory framework for online business operations.

Unit V:
Security issues in e commerce; cyber threats; encryption basics; digital signatures; trust and privacy; emerging trends in electronic commerce.

Text Books

1. Kalakota, R., & Whinston, A. B. (2019). *Electronic commerce*. Pearson.
2. Turban, E., King, D., Lee, J., Liang, T. P., & Turban, D. (2018). *Electronic commerce*. Springer.
3. Chaffey, D. (2020). *Digital business and e commerce management*. Pearson.
4. Laudon, K. C., & Traver, C. G. (2021). *E commerce*. Pearson.
5. Schneider, G. P. (2019). *Electronic commerce*. Cengage.

Reference Books

1. Rayport, J. F., & Jaworski, B. J. (2018). *Introduction to e commerce*. McGraw Hill.
2. Zwass, V. (2017). *Electronic commerce*. Springer.
3. Dave, C. (2019). *E commerce strategies*. Wiley.
4. Jelassi, T., & Enders, A. (2020). *Strategies for e business*. Pearson.
5. Plant, R. (2018). *E commerce: Formulation of strategy*. Prentice Hall.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Business Law

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamentals of business law.
2. Understand Indian Contract Act provisions.
3. Examine laws relating to sale of goods.
4. Analyze negotiable instruments and company law basics.
5. Build legal awareness for business operations.

Course Outcomes

- CO1: Understand basic legal concepts for business.
- CO2: Interpret contract law provisions.
- CO3: Analyze sale of goods regulations.
- CO4: Understand negotiable instruments.
- CO5: Apply legal principles in business situations.

Detailed Syllabus

Unit I:
Business law meaning, scope; sources of business law; law and commerce relationship; Indian legal system overview; rights and obligations in commercial activities.

Unit II:
Indian Contract Act essentials; offer and acceptance; consideration; capacity of parties; free consent; legality of object; classification of contracts.

Unit III:
Sale of Goods Act provisions; conditions and warranties; transfer of ownership; performance of contract; rights of unpaid seller; remedies.

Unit IV:
Negotiable Instruments Act; promissory note, bill of exchange, cheque; endorsement; dishonor; legal implications; banking relevance.

Unit V:
Introduction to company law; types of companies; incorporation process; memorandum and articles of association; corporate legal compliance basics.

Text Books

1. Kapoor, N. D. (2020). *Business law*. Sultan Chand & Sons.
2. Tulsian, P. C. (2019). *Business law*. McGraw Hill.
3. Singh, A. K. (2018). *Business law*. Eastern Book Company.
4. Pathak, A. (2020). *Legal aspects of business*. McGraw Hill.
5. Garg, R. K. (2019). *Mercantile law*. Sultan Chand.

Reference Books

1. Avtar Singh. (2018). *Business law*. Eastern Book Company.
2. Sharma, J. P. (2019). *Business law*. Taxmann.
3. Kuchhal, M. C. (2017). *Mercantile law*. Vikas Publishing.
4. Maheshwari, S. N. (2018). *Business law*. Himalaya.
5. Pandey, S. (2020). *Business law*. Central Law Agency.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce design thinking concepts.
2. Develop creative problem solving skills.
3. Encourage innovation mindset.

4. Apply design thinking to business challenges.
5. Promote user centric solution development.

Course Outcomes

- CO1: Understand design thinking framework.
- CO2: Apply creative problem solving techniques.
- CO3: Develop innovative business ideas.
- CO4: Use user centric design approaches.
- CO5: Prototype and test business solutions.

Detailed Syllabus

Unit I:
Design thinking meaning; principles; importance; innovation concepts; creativity in business; difference between traditional and design based problem solving approaches.

Unit II:
Empathy stage; user research methods; observation techniques; problem identification; need analysis; stakeholder mapping; insight generation.

Unit III:
Ideation techniques; brainstorming; mind mapping; creative tools; idea evaluation; feasibility analysis; selection of innovative solutions.

Unit IV:
Prototyping concepts; low fidelity and high fidelity prototypes; testing methods; feedback incorporation; iterative design process.

Unit V:
Design thinking applications; business innovation cases; startups and entrepreneurship relevance; organizational innovation culture; future of innovation.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.
2. Kelley, T., & Kelley, D. (2018). *Creative confidence*. Crown Business.
3. Liedtka, J., & Ogilvie, T. (2019). *Designing for growth*. Columbia University Press.
4. Martin, R. L. (2018). *The design of business*. Harvard Business Press.
5. Kelley, T. (2017). *The art of innovation*. Currency.

Reference Books

1. Plattner, H., Meinel, C., & Leifer, L. (2018). *Design thinking research*. Springer.

2. Cross, N. (2019). *Design thinking*. Bloomsbury.
3. Verganti, R. (2017). *Design driven innovation*. Harvard Business Press.
4. Osterwalder, A., & Pigneur, Y. (2018). *Business model generation*. Wiley.
5. IDEO. (2015). *The field guide to human centered design*. IDEO.

Evaluation Scheme

Continuous Assessment (50%) + End-Semester Examination (50%)

Internship / Digital Business Exposure

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to digital business environment.
2. Understand real world business processes.
3. Develop professional skills and ethics.
4. Relate academic concepts to practice.
5. Enhance employability readiness.

Course Outcomes

- CO1: Observe digital business operations.
- CO2: Identify functional roles in organizations.
- CO3: Apply classroom knowledge to practice.
- CO4: Prepare structured internship report.
- CO5: Demonstrate professional discipline.

Guidelines

Industry attachment, task observation, supervised participation, documentation of learning, reflective reporting, mentor evaluation.

Evaluation Scheme

Internship Report (60%) + Viva-Voce (40%)

SEMESTER III

Corporate Accounting

Course Category: Accounting & Finance Core
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop understanding of corporate accounting principles.
2. Enable preparation of company financial statements.
3. Analyze accounting treatment of share capital and debentures.
4. Understand valuation and accounting for profits and reserves.
5. Support compliance with corporate accounting standards.

Course Outcomes

- CO1: Prepare company financial statements.
- CO2: Apply accounting treatment for share capital.
- CO3: Account for debentures and reserves.
- CO4: Analyze corporate financial information.
- CO5: Ensure compliance with statutory requirements.

Detailed Syllabus

Unit I:
Corporate accounting framework, features of companies; types of companies; share capital concepts; issue of shares, forfeiture, reissue; accounting entries; statutory provisions; compliance orientation; numerical illustrations for company formation.

Unit II:
Debentures meaning, types; issue and redemption of debentures; accounting treatment; interest on debentures; debenture redemption reserve; statutory compliance; practical problems; corporate finance linkage.

Unit III:
Final accounts of companies; statement of profit and loss; balance sheet preparation; adjustments; depreciation; managerial remuneration; compliance with Companies Act provisions; numerical illustrations.

Unit IV:
Valuation of shares meaning and necessity; methods of valuation; net asset method; yield method; fair value method; practical illustrations; relevance in corporate restructuring.

Unit V:
Holding company accounts; consolidation concepts; preparation of consolidated balance sheet; minority interest; cost of control; compliance requirements; numerical problem solving orientation.

Text Books

1. Jain, S. P., & Narang, K. L. (2021). *Corporate accounting*. Kalyani Publishers.
2. Gupta, R. L., & Radhaswamy, M. (2020). *Corporate accounting*. Sultan Chand & Sons.
3. Shukla, M. C., Grewal, T. S., & Gupta, S. C. (2019). *Advanced accounts*. S. Chand.
4. Anthony, R. N., & Reece, J. S. (2018). *Accounting principles*. Irwin.
5. Wood, F., & Sangster, A. (2020). *Business accounting*. Pearson.

Reference Books

1. Lal, J. (2020). *Accounting theory*. Tata McGraw Hill.
2. Libby, R., Libby, P., & Short, D. (2019). *Financial accounting*. McGraw Hill.
3. Stickney, C. P., & Weil, R. L. (2018). *Financial accounting*. South-Western.
4. Needles, B. E., & Powers, M. (2017). *Principles of accounting*. Cengage.
5. Meigs, R. F., & Meigs, W. B. (2019). *Accounting*. McGraw Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Marketing & Analytics

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand digital marketing ecosystem.
2. Analyze online consumer behavior.
3. Apply digital marketing tools and platforms.
4. Interpret marketing analytics for decision making.
5. Integrate digital strategies with business objectives.

Course Outcomes

- CO1: Explain digital marketing concepts.

- CO2: Apply online marketing tools.
- CO3: Analyze digital consumer data.
- CO4: Interpret marketing analytics reports.
- CO5: Design digital marketing strategies.

Detailed Syllabus

Unit I:
Digital marketing overview; evolution of digital commerce; online consumer behavior; digital marketing channels; owned, earned, paid media; strategic framework; relevance for modern business organizations.

Unit II:
Search engine marketing; search engine optimization concepts; keyword analysis; on page and off page optimization; paid search advertising; performance metrics; campaign evaluation techniques.

Unit III:
Social media marketing; platforms and tools; content marketing strategies; influencer marketing; engagement metrics; community management; brand building through digital channels.

Unit IV:
Web analytics fundamentals; data collection tools; Google Analytics overview; traffic analysis; conversion metrics; customer acquisition cost; analytical interpretation for marketing decisions.

Unit V:
Email marketing; mobile marketing; marketing automation; digital marketing ethics; data privacy considerations; integrated digital campaigns; emerging trends and technologies.

Text Books

1. Chaffey, D., & Ellis-Chadwick, F. (2020). *Digital marketing* (7th ed.). Pearson.
2. Ryan, D. (2019). *Understanding digital marketing*. Kogan Page.
3. Strauss, J., & Frost, R. (2020). *E-marketing*. Pearson.
4. Kingsnorth, S. (2020). *Digital marketing strategy*. Kogan Page.
5. Tuten, T. L., & Solomon, M. R. (2018). *Social media marketing*. Sage.

Reference Books

1. Kaushik, A. (2018). *Web analytics 2.0*. Wiley.
2. Clifton, B. (2019). *Advanced web metrics*. Wiley.
3. Kotler, P., Kartajaya, H., & Setiawan, I. (2021). *Marketing 5.0*. Wiley.

4. Ryan, D., & Jones, C. (2019). *Understanding digital marketing*. Kogan Page.
5. Evans, D. (2018). *Social media marketing*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Banking & Financial Systems

Course Category: Accounting & Finance Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand structure and functions of banking system.
2. Examine role of banks in financial intermediation.
3. Analyze Indian financial system components.
4. Introduce modern banking products and services.
5. Develop awareness of regulatory framework.

Course Outcomes

- CO1: Explain banking system structure and functions.
- CO2: Identify banking products and services.
- CO3: Analyze role of banks in economic development.
- CO4: Understand financial system institutions.
- CO5: Interpret regulatory and supervisory mechanisms.

Detailed Syllabus

Unit I:
Banking concepts, evolution of banking; functions of commercial banks; types of banks; branch banking, unit banking; role of banking in economic development; relationship between banking and commerce sectors.

Unit II:
Banking products and services; deposits, loans, advances; credit creation process; interest rate concepts; priority sector lending; retail banking services; customer relationship dimensions in banking.

Unit III:
Indian financial system overview; money market and capital market; financial institutions; role of RBI; NBFCs; development financial institutions; integration of financial markets.

Unit IV:
Central banking functions; monetary policy instruments; bank rate, repo rate; open market operations; cash reserve ratio; statutory liquidity ratio; impact on banking operations.

Unit V:
Modern banking trends; electronic banking; mobile banking; internet banking; financial inclusion initiatives; challenges in banking sector; risk management overview.

Text Books

1. Indian Institute of Banking & Finance. (2020). *Principles and practices of banking*. Macmillan.
2. Shekhar, K. C., & Shekhar, L. (2019). *Banking theory and practice*. Vikas Publishing.
3. Gordan, E., & Natarajan, K. (2018). *Banking theory law and practice*. Himalaya.
4. Mishkin, F. S. (2019). *The economics of money, banking and financial markets*. Pearson.
5. Varshney, P. N. (2018). *Indian financial system*. Sultan Chand.

Reference Books

1. Bhole, L. M. (2017). *Financial institutions and markets*. McGraw Hill.
2. Khan, M. Y. (2019). *Indian financial system*. Tata McGraw Hill.
3. Saunders, A., & Cornett, M. M. (2020). *Financial institutions management*. McGraw Hill.
4. Rose, P. S., & Hudgins, S. C. (2019). *Bank management and financial services*. McGraw Hill.
5. RBI. (2022). *Report on trend and progress of banking in India*. RBI.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Financial Management

Course Category: Accounting & Finance Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of financial management.
2. Understand financial decision making areas.
3. Analyze capital budgeting techniques.

4. Examine working capital management.
5. Build foundation for investment and financing decisions.

Course Outcomes

- CO1: Explain scope and objectives of financial management.
- CO2: Analyze capital structure decisions.
- CO3: Apply capital budgeting techniques.
- CO4: Manage working capital components.
- CO5: Interpret financial performance indicators.

Detailed Syllabus

Unit I:
Financial management meaning, scope; objectives; profit versus wealth maximization; financial decision areas; role of finance manager; relationship between finance and other business functions.

Unit II:
Capital structure concepts; equity and debt financing; leverage analysis; cost of capital concepts; factors influencing capital structure decisions; optimal capital mix considerations.

Unit III:
Capital budgeting techniques; payback period; net present value; internal rate of return; profitability index; investment appraisal decision making; risk considerations.

Unit IV:
Working capital management; meaning and components; cash management; inventory management; receivables management; liquidity analysis; short term financing sources.

Unit V:
Financial performance analysis; ratio analysis; profitability ratios; liquidity ratios; leverage ratios; interpretation for managerial decision making.

Text Books

1. Khan, M. Y., & Jain, P. K. (2020). *Financial management*. McGraw Hill.
2. Pandey, I. M. (2021). *Financial management*. Vikas Publishing.
3. Brigham, E. F., & Ehrhardt, M. C. (2019). *Financial management*. Cengage.
4. Van Horne, J. C., & Wachowicz, J. M. (2018). *Fundamentals of financial management*. Pearson.
5. Chandra, P. (2019). *Financial management*. McGraw Hill.

Reference Books

1. Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2020). *Fundamentals of corporate finance*. McGraw Hill.
2. Damodaran, A. (2018). *Applied corporate finance*. Wiley.
3. Brealey, R. A., Myers, S. C., & Allen, F. (2019). *Principles of corporate finance*. McGraw Hill.
4. Higgins, R. C. (2019). *Analysis for financial management*. McGraw Hill.
5. Weston, J. F., & Brigham, E. F. (2017). *Managerial finance*. Dryden.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Information Systems for Business

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand role of information systems in business.
2. Examine types of business information systems.
3. Analyze data management and decision support systems.
4. Understand enterprise systems integration.
5. Develop awareness of digital transformation.

Course Outcomes

- CO1: Explain business information system concepts.
- CO2: Identify functional information systems.
- CO3: Analyze data and decision support tools.
- CO4: Understand enterprise applications.
- CO5: Apply IS concepts in business contexts.

Detailed Syllabus

Unit I:
Information systems concepts; components of IS; data, information, knowledge; role of IS in organizations; strategic importance of information systems in business competitiveness.

Unit II:
Types of information systems; transaction processing systems; management information

systems; decision support systems; executive information systems; functional area applications.

Unit III:
Database concepts; data management; data warehousing; data mining basics; business intelligence tools; information quality and security considerations.

Unit IV:
Enterprise resource planning systems; CRM, SCM concepts; integration of business processes; benefits and challenges of enterprise systems implementation.

Unit V:
Digital transformation; cloud computing overview; emerging technologies; IS governance; ethical and legal issues; future trends in business information systems.

Text Books

1. Laudon, K. C., & Laudon, J. P. (2020). *Management information systems*. Pearson.
2. O'Brien, J. A., & Marakas, G. M. (2019). *Management information systems*. McGraw Hill.
3. Turban, E., Pollard, C., & Wood, G. (2018). *Information technology for management*. Wiley.
4. Stair, R., & Reynolds, G. (2019). *Principles of information systems*. Cengage.
5. Haag, S., & Cummings, M. (2018). *Management information systems*. McGraw Hill.

Reference Books

1. Pearlson, K. E., Saunders, C. S., & Galletta, D. F. (2019). *Managing and using information systems*. Wiley.
2. McNurlin, B. C., Sprague, R. H., & Bui, T. (2018). *Information systems management*. Pearson.
3. Galliers, R. D., & Leidner, D. E. (2019). *Strategic information management*. Routledge.
4. Chen, H., Chiang, R., & Storey, V. (2018). *Business intelligence*. MIS Quarterly.
5. Watson, H. J. (2019). *Business intelligence*. Morgan Kaufmann.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Ethics / Indian Knowledge Systems)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce ethical principles in personal and professional life.
2. Understand Indian knowledge traditions.
3. Examine value based decision making.
4. Promote social responsibility awareness.
5. Integrate ethics with business practices.

Course Outcomes

- CO1: Understand ethical concepts and values.
- CO2: Relate Indian knowledge systems to society.
- CO3: Analyze ethical dilemmas in business.
- CO4: Apply value based decision frameworks.
- CO5: Demonstrate socially responsible behavior.

Detailed Syllabus

Unit I:
Ethics meaning, nature, importance; values and morality; ethics in personal and professional life; relevance of ethics in business environments.

Unit II:
Indian knowledge systems overview; Vedic traditions; philosophical foundations; contribution to science, management, and society; cultural perspectives.

Unit III:
Business ethics concepts; ethical decision making; corporate ethics; codes of conduct; ethical leadership; stakeholder responsibility.

Unit IV:
Social responsibility; sustainability concepts; inclusive development; ethical challenges in globalization; role of organizations in society.

Unit V:
Contemporary ethical issues; technology and ethics; digital ethics; future ethical challenges; integration of ethics in professional life.

Text Books

1. Velasquez, M. G. (2018). *Business ethics*. Pearson.

2. Sharma, R. K. (2019). *Indian ethos and values*. Himalaya.
3. Chakraborty, S. K. (2018). *Ethics in management*. Oxford University Press.
4. Radhakrishnan, S. (2017). *Indian philosophy*. Oxford University Press.
5. Fernando, A. C. (2019). *Business ethics*. Pearson India.

Reference Books

1. Sen, A. (2019). *The idea of justice*. Harvard University Press.
2. Gandhi, M. K. (2018). *Hind Swaraj*. Navajivan.
3. Boatright, J. R. (2018). *Ethics and the conduct of business*. Pearson.
4. Nussbaum, M. (2019). *Creating capabilities*. Harvard University Press.
5. Upadhyaya, K. (2020). *Indian knowledge systems*. PHI Learning.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to organizational working environment.
2. Relate academic knowledge with industry practices.
3. Develop professional skills and discipline.
4. Enhance employability and career awareness.
5. Build reporting and presentation abilities.

Course Outcomes

- CO1: Observe industry operations and workflows.
- CO2: Identify functional business activities.
- CO3: Apply theoretical concepts to practice.
- CO4: Prepare structured internship report.
- CO5: Demonstrate professional conduct.

Guidelines

Industry attachment, task observation, supervised participation, documentation of learning outcomes, report submission, viva voce assessment.

Evaluation Scheme

Internship Report (60%) + Viva-Voce (40%)

SEMESTER IV

Financial Technologies (FinTech)

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop understanding of financial technology ecosystem.
2. Examine digital disruption in financial services.
3. Analyze FinTech business models and platforms.
4. Understand regulatory and compliance dimensions of FinTech.
5. Enable application of FinTech solutions in commerce.

Course Outcomes

- CO1: Identify major FinTech domains and technologies.
- CO2: Analyze digital financial service models.
- CO3: Evaluate FinTech applications in banking and finance.
- CO4: Assess regulatory and security challenges.
- CO5: Apply FinTech concepts to business scenarios.

Detailed Syllabus

Unit I:
Financial technology evolution, FinTech ecosystem; digital disruption in finance; drivers of FinTech growth; traditional versus digital finance; stakeholders, platforms, innovation models; role of technology in modern financial services.

Unit II:
Digital lending platforms; peer to peer lending; crowdfunding models; credit scoring technologies; alternative data usage; risk assessment mechanisms; business applications and financial inclusion perspectives.

Unit III:
Robo advisory services; algorithm based investment advisory; wealth management platforms; automation in financial planning; customer profiling; portfolio rebalancing techniques; efficiency and scalability considerations.

Unit IV:
RegTech overview; compliance automation; regulatory reporting technologies; KYC, AML

systems; risk monitoring tools; governance frameworks; role of technology in regulatory compliance management.

Unit V:
Challenges in FinTech adoption; cybersecurity risks; data privacy issues; ethical considerations; future trends in FinTech; global developments; integration of FinTech with traditional financial institutions.

Text Books

1. Arner, D. W., Barberis, J., & Buckley, R. P. (2020). *The evolution of FinTech*. Oxford University Press.
2. Gomber, P., Koch, J. A., & Siering, M. (2018). *Digital finance and FinTech*. Springer.
3. Nicoletti, B. (2019). *FinTech innovation*. Palgrave Macmillan.
4. Chishti, S., & Barberis, J. (2016). *The FinTech book*. Wiley.
5. Dorfleitner, G., Hornuf, L., Schmitt, M., & Weber, M. (2019). *FinTech in Germany*. Springer.

Reference Books

1. Zavolokina, L., Dolata, M., & Schwabe, G. (2017). *FinTech transformation*. Springer.
2. Lee, I., & Shin, Y. J. (2018). *FinTech ecosystem*. Business Horizons.
3. Gai, K., Qiu, M., & Sun, X. (2018). *A survey on FinTech*. IEEE Access.
4. Haddad, C., & Hornuf, L. (2019). *The emergence of FinTech*. Small Business Economics.
5. Philippon, T. (2020). *On FinTech and financial efficiency*. Journal of Finance.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Electronic Payment Systems & Digital Banking

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand evolution of electronic payment systems.
2. Examine digital banking architecture and services.
3. Analyze payment instruments and settlement mechanisms.
4. Understand regulatory and security frameworks.

5. Apply digital payment knowledge to commerce operations.

Course Outcomes

- CO1: Identify electronic payment instruments and platforms.
- CO2: Analyze digital banking services and processes.
- CO3: Understand payment clearing and settlement systems.
- CO4: Assess security and regulatory issues.
- CO5: Apply digital payment solutions in business contexts.

Detailed Syllabus

Unit I:
Electronic payment systems overview; evolution of payment systems; cashless economy concepts; payment system participants; advantages and challenges; role of electronic payments in digital commerce ecosystems.

Unit II:
Digital banking concepts; core banking solutions; internet banking; mobile banking; digital banking services; customer onboarding processes; service delivery models in banking.

Unit III:
Payment instruments; debit cards, credit cards; prepaid instruments; UPI systems; wallets; QR code payments; transaction flow; user experience considerations.

Unit IV:
Payment clearing and settlement; RTGS, NEFT, IMPS; payment gateways; interoperability; settlement risk; operational efficiency; role of payment service providers.

Unit V:
Security and regulation; payment security standards; authentication mechanisms; fraud risks; RBI guidelines; data protection; compliance requirements in digital payment systems.

Text Books

1. Ghosh, S. (2020). *Digital banking and electronic payment systems*. PHI Learning.
2. Sharma, R. (2019). *Electronic payment systems*. Himalaya Publishing.
3. RBI. (2021). *Payment and settlement systems in India*. RBI Publications.
4. Arora, R. (2018). *Digital banking*. Wiley India.
5. Rose, P. S., & Hudgins, S. C. (2019). *Bank management and financial services*. McGraw Hill.

Reference Books

1. Mishkin, F. S. (2019). *The economics of money, banking and financial markets*. Pearson.
2. Khan, M. Y. (2019). *Indian financial system*. Tata McGraw Hill.
3. Saunders, A., & Cornett, M. M. (2020). *Financial institutions management*. McGraw Hill.
4. RBI. (2022). *Annual report*. RBI.
5. Gomber, P., Koch, J. A., & Siering, M. (2018). *Digital finance*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Cost & Management Accounting

Course Category: Accounting & Finance Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce cost accounting principles and methods.
2. Analyze cost behavior and classification.
3. Support managerial planning and control.
4. Understand budgeting and standard costing.
5. Enable cost based decision making.

Course Outcomes

- CO1: Classify and analyze cost elements.
- CO2: Prepare cost statements.
- CO3: Apply budgeting and control techniques.
- CO4: Analyze marginal costing decisions.
- CO5: Support managerial decision making using cost data.

Detailed Syllabus

Unit I:
Cost accounting concepts; objectives; cost classification; cost elements; cost centers and cost units; relationship between financial and cost accounting; relevance for managerial decision processes.

Unit II:
Material costing; purchase procedures; inventory control techniques; EOQ; pricing of material issues; labour costing; wage systems; incentive plans.

Unit III:
Overheads concepts; classification and allocation; absorption of overheads; machine hour rate; overhead control; practical cost computation orientation.

Unit IV:
Budgetary control; functional budgets; cash budget; flexible budgets; standard costing concepts; variance analysis; cost control implications.

Unit V:
Marginal costing; break even analysis; contribution concept; cost volume profit analysis; managerial decision areas; pricing, make or buy decisions.

Text Books

1. Jain, S. P., & Narang, K. L. (2020). *Cost accounting*. Kalyani Publishers.
2. Arora, M. N. (2019). *Cost and management accounting*. Vikas Publishing.
3. Khan, M. Y., & Jain, P. K. (2018). *Management accounting*. McGraw Hill.
4. Horngren, C. T., et al. (2019). *Cost accounting*. Pearson.
5. Maheshwari, S. N. (2018). *Cost accounting*. Vikas Publishing.

Reference Books

1. Drury, C. (2018). *Management and cost accounting*. Cengage.
2. Kaplan, R. S., & Atkinson, A. A. (2019). *Advanced management accounting*. Pearson.
3. Garrison, R. H., et al. (2020). *Managerial accounting*. McGraw Hill.
4. Lal, J. (2019). *Cost accounting*. Tata McGraw Hill.
5. Blocher, E. J. (2019). *Cost management*. McGraw Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Cyber Security & Data Protection for Commerce

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand cyber security fundamentals.
2. Identify threats and vulnerabilities in digital commerce.
3. Examine data protection mechanisms.
4. Understand legal and regulatory frameworks.
5. Promote secure digital business practices.

Course Outcomes

- CO1: Identify cyber threats and risks.
- CO2: Apply basic security controls.
- CO3: Understand data protection principles.
- CO4: Interpret cyber laws and compliance.
- CO5: Promote cyber security awareness in business.

Detailed Syllabus

Unit I:
Cyber security concepts; information security principles; confidentiality, integrity, availability; cyber threats overview; relevance for digital commerce and financial systems.

Unit II:
Types of cyber attacks; malware, phishing, ransomware; social engineering; attack vectors; impact on business operations; risk exposure assessment.

Unit III:
Security controls; authentication mechanisms; access control; encryption basics; network security concepts; firewalls; intrusion detection systems.

Unit IV:
Data protection concepts; personal data, sensitive data; data lifecycle; privacy principles; data breach management; organizational responsibilities.

Unit V:
Cyber laws and regulations; IT Act provisions; data protection regulations; compliance requirements; cyber security governance; emerging challenges.

Text Books

1. Whitman, M. E., & Mattord, H. J. (2020). *Principles of information security*. Cengage.
2. Peltier, T. R. (2018). *Information security policies*. Auerbach.
3. Stallings, W. (2019). *Network security essentials*. Pearson.
4. Calder, A. (2019). *Cyber security*. IT Governance.
5. Kizza, J. M. (2018). *Guide to computer network security*. Springer.

Reference Books

1. Anderson, R. (2020). *Security engineering*. Wiley.
2. Schneier, B. (2019). *Applied cryptography*. Wiley.
3. OECD. (2019). *Digital security risk management*. OECD.
4. Casey, E. (2018). *Digital evidence and computer crime*. Academic Press.
5. Solove, D. J. (2020). *Understanding privacy*. Harvard University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I

(Business Analytics / Supply Chain Management)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce analytical and supply chain perspectives for business decision making.
2. Develop understanding of data driven managerial insights.
3. Examine operational and logistics coordination mechanisms.
4. Apply quantitative tools to business and supply chain problems.
5. Support strategic planning through analytics and supply chain concepts.

Course Outcomes

- CO1: Understand fundamentals of business analytics and supply chains.
- CO2: Analyze data and processes for managerial decisions.
- CO3: Apply analytical tools to operational scenarios.
- CO4: Interpret supply chain structures and performance measures.

- CO5: Integrate analytics with supply chain strategy.

Detailed Syllabus

Unit I:
Business analytics meaning, scope, importance; descriptive, predictive, prescriptive analytics; data driven decision making; role of analytics in modern organizations; relationship between analytics, operations, and competitive advantage in business environments.

Unit II:
Data types and sources; structured and unstructured data; data collection methods; data preparation; data visualization concepts; dashboards; interpretation of business data patterns; managerial insights derived from analytical summaries.

Unit III:
Supply chain management concepts; components of supply chain; suppliers, manufacturers, distributors, retailers; logistics and information flows; coordination mechanisms; importance of supply chain integration for cost efficiency and service effectiveness.

Unit IV:
Quantitative tools overview; forecasting methods; demand planning; inventory management basics; EOQ concepts; safety stock; performance measurement; key supply chain metrics; analytics supported operational planning and control.

Unit V:
Strategic issues in analytics and supply chain; digital technologies impact; supply chain resilience; risk management; sustainability considerations; role of analytics in strategic sourcing and distribution decisions; emerging trends and future directions.

Text Books

1. Evans, J. R. (2018). *Business analytics*. Pearson Education.
2. Chopra, S., & Meindl, P. (2020). *Supply chain management: Strategy, planning, and operation* (7th ed.). Pearson.
3. Sharda, R., Delen, D., & Turban, E. (2019). *Business intelligence, analytics, and data science*. Pearson.
4. Camm, J. D., Cochran, J. J., Fry, M. J., Ohlmann, J. W., & Anderson, D. R. (2020). *Business analytics*. Cengage Learning.
5. Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2019). *Designing and managing the supply chain*. McGraw Hill.

Reference Books

1. Watson, H. J. (2019). *Business analytics*. Pearson.

2. Laudon, K. C., & Laudon, J. P. (2020). *Management information systems*. Pearson.
3. Hugos, M. (2018). *Essentials of supply chain management*. Wiley.
4. Silver, E. A., Pyke, D. F., & Thomas, D. J. (2017). *Inventory and production management*. CRC Press.
5. Davenport, T. H., & Harris, J. G. (2017). *Competing on analytics*. Harvard Business School Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Commerce Laboratory

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop practical skills in digital commerce tools.
2. Apply e commerce technologies in business scenarios.
3. Perform analytics using digital platforms.
4. Understand digital transaction workflows.
5. Strengthen hands on digital business competencies.

Course Outcomes

- CO1: Use digital commerce platforms effectively.
- CO2: Perform online business operations.
- CO3: Apply analytics tools for digital data.
- CO4: Execute secure digital transactions.
- CO5: Integrate digital tools for commerce applications.

List of Experiments / Exercises

1. Creation of e commerce storefront using online platforms; product listing, pricing, catalog management; application of digital selling skills.
2. Execution of online order processing workflow; cart management, checkout process, order fulfillment; understanding transaction lifecycle.
3. Use of digital payment gateways in simulated environment; payment processing, confirmation, reconciliation; exposure to electronic payments.

4. Web traffic analysis using analytics tools; data collection, dashboard interpretation, user behavior analysis; analytical skill development.
5. Social media business page creation; content posting, engagement tracking, audience insights; digital marketing exposure.
6. Search engine optimization practice; keyword selection, on page optimization, performance monitoring; visibility enhancement skills.
7. Email marketing campaign design; list management, campaign execution, response analysis; customer communication skills.
8. Cybersecurity practice for digital commerce; password management, basic threat identification, data protection measures; security awareness.
9. Inventory management using digital tools; stock tracking, reorder levels, reporting; operational efficiency skills.
10. Preparation of digital commerce performance report; KPI identification, data interpretation, presentation skills; business decision support.
11. Case based exercise on digital business models; analysis, comparison, presentation; strategic understanding development.

Expected Outcomes

Operational proficiency in digital commerce platforms, analytics tools, electronic payments, and secure online business practices.

Evaluation Scheme

Continuous Assessment (60%) + End-SEMESTER Practical Examination (40%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Structure:
Course Objectives – Internship Guidelines – Expected Outcomes – Evaluation Scheme

SEMESTER V

Blockchain Technology & Applications in Finance

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop conceptual understanding of blockchain technology foundations.
2. Examine decentralized ledger architecture and consensus mechanisms.
3. Analyze blockchain applications in financial services.
4. Understand smart contracts and crypto assets.
5. Evaluate regulatory and security considerations in blockchain adoption.

Course Outcomes

- CO1: Explain blockchain architecture and operational principles.
- CO2: Analyze distributed ledger and consensus mechanisms.
- CO3: Apply blockchain concepts to financial use cases.
- CO4: Evaluate smart contracts and digital assets.
- CO5: Assess risks, regulations, and future trends in blockchain finance.

Detailed Syllabus

Unit I:
Blockchain fundamentals, distributed ledger concepts; decentralization principles; blocks, hashing, cryptography basics; peer to peer networks; immutability features; trustless systems; comparison with traditional centralized databases in financial environments.

Unit II:
Consensus mechanisms overview; proof of work, proof of stake; Byzantine fault tolerance; mining concepts; transaction validation; scalability challenges; energy considerations; performance trade offs in blockchain based financial systems.

Unit III:
Cryptocurrencies fundamentals; Bitcoin and altcoins; wallets, exchanges; tokenization concepts; initial coin offerings; stablecoins; use of crypto assets in payments, remittances, and cross border financial transactions.

Unit IV:
Smart contracts concepts; Ethereum framework; decentralized applications; automated

execution; use cases in lending, insurance, trade finance; benefits and limitations; operational risks in programmable financial contracts.

Unit V:
Blockchain regulation and governance; compliance challenges; security threats; privacy issues; enterprise blockchain adoption; future trends; integration with traditional financial institutions; impact on global financial ecosystems.

Text Books

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and cryptocurrency technologies*. Princeton University Press.
2. Antonopoulos, A. M. (2018). *Mastering Bitcoin* (2nd ed.). O'Reilly Media.
3. Tapscott, D., & Tapscott, A. (2018). *Blockchain revolution*. Portfolio.
4. Drescher, D. (2017). *Blockchain basics*. Apress.
5. Mougayar, W. (2016). *The business blockchain*. Wiley.

Reference Books

1. Swan, M. (2015). *Blockchain: Blueprint for a new economy*. O'Reilly Media.
2. Pilkington, M. (2016). *Blockchain technology*. Edward Elgar.
3. Bashir, I. (2018). *Mastering blockchain*. Packt.
4. Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). *Blockchain technology*. Applied Innovation Review.
5. Yaga, D., Mell, P., Roby, N., & Scarfone, K. (2019). *Blockchain technology overview*. NIST.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

International E-Commerce & Trade Regulations

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand international trade and e commerce frameworks.
2. Examine cross border e commerce business models.
3. Analyze global trade regulations and agreements.
4. Understand customs, documentation, and compliance procedures.

5. Apply regulatory knowledge to international digital trade.

Course Outcomes

- CO1: Explain international e commerce concepts and scope.
- CO2: Analyze global trade policies affecting e commerce.
- CO3: Understand export import documentation procedures.
- CO4: Interpret international trade regulations and compliance.
- CO5: Apply regulatory frameworks to global digital business.

Detailed Syllabus

Unit I:
International trade concepts; globalization; evolution of international e commerce; cross border digital trade; drivers of global e commerce growth; role of technology in international market expansion.

Unit II:
International trade theories; comparative advantage; absolute advantage; modern trade theories; relevance for global e commerce strategy formulation and market selection decisions.

Unit III:
International trade regulations; WTO framework; trade agreements; tariff and non tariff barriers; trade facilitation measures; implications for digital commerce operations.

Unit IV:
Export import procedures; documentation; customs clearance; INCOTERMS; logistics and shipping; payment methods in international trade; risk mitigation practices.

Unit V:
Legal and compliance issues in international e commerce; taxation; data localization; consumer protection; dispute resolution; challenges and emerging trends in global digital trade.

Text Books

1. Daniels, J. D., Radebaugh, L. H., & Sullivan, D. P. (2020). *International business*. Pearson.
2. Hill, C. W. L. (2021). *International business*. McGraw Hill.
3. Cateora, P. R., Gilly, M. C., & Graham, J. L. (2019). *International marketing*. McGraw Hill.
4. Cherunilam, F. (2020). *International trade and export management*. Himalaya Publishing.

5. WTO. (2018). *World trade report*. WTO Publications.

Reference Books

1. Krugman, P. R., Obstfeld, M., & Melitz, M. J. (2019). *International economics*. Pearson.
2. Carbaugh, R. J. (2020). *International economics*. Cengage.
3. UNCTAD. (2021). *Digital economy report*. United Nations.
4. Bhattacharya, B. (2019). *Global trade and commerce*. Oxford University Press.
5. Paul, J. (2018). *International business*. McGraw Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Investment Analysis & Portfolio Management

Course Category: Accounting & Finance Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce investment environment and asset classes.
2. Analyze risk and return characteristics of investments.
3. Understand portfolio construction principles.
4. Examine security valuation models.
5. Support informed investment decision making.

Course Outcomes

- CO1: Understand investment avenues and markets.
- CO2: Analyze risk return trade off.
- CO3: Apply portfolio management principles.
- CO4: Evaluate securities using valuation models.
- CO5: Interpret market information for investment decisions.

Detailed Syllabus

Unit I:
Investment concepts; investment environment; financial markets overview; asset classes; equity, debt, mutual funds; investment objectives; investor behavior; role of investment in wealth creation.

Unit II:
Risk and return concepts; types of risk; measurement of return; standard deviation; beta; diversification benefits; systematic and unsystematic risk; portfolio risk considerations.

Unit III:
Security analysis overview; fundamental analysis; economic, industry, company analysis; financial statement analysis; qualitative and quantitative evaluation of securities.

Unit IV:
Technical analysis concepts; price trends; charts and patterns; indicators; moving averages; market timing; limitations of technical analysis.

Unit V:
Portfolio management; portfolio theory; efficient frontier; capital asset pricing model; portfolio revision; performance evaluation; ethical considerations in investment management.

Text Books

1. Bodie, Z., Kane, A., & Marcus, A. J. (2021). *Investments*. McGraw Hill.
2. Sharpe, W. F., Alexander, G. J., & Bailey, J. V. (2019). *Investments*. Pearson.
3. Reilly, F. K., & Brown, K. C. (2020). *Investment analysis and portfolio management*. Cengage.
4. Fischer, D. E., & Jordan, R. J. (2018). *Security analysis and portfolio management*. Pearson.
5. Jones, C. P. (2019). *Investments*. Wiley.

Reference Books

1. Elton, E. J., Gruber, M. J., Brown, S. J., & Goetzmann, W. N. (2019). *Modern portfolio theory*. Wiley.
2. Damodaran, A. (2018). *Investment valuation*. Wiley.
3. Fabozzi, F. J. (2018). *Bond markets, analysis and strategies*. Pearson.
4. Graham, B., & Dodd, D. (2019). *Security analysis*. McGraw Hill.
5. Bernstein, P. L. (2018). *Against the gods*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Taxation & GST in Digital Business

Course Category: Accounting & Finance Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of taxation in India.
2. Examine structure and mechanism of GST.
3. Analyze taxation issues in digital business.
4. Understand compliance and filing procedures.
5. Apply tax knowledge to business decision making.

Course Outcomes

- CO1: Explain fundamentals of taxation.
- CO2: Understand GST structure and provisions.
- CO3: Analyze tax implications for digital business.
- CO4: Apply GST compliance procedures.
- CO5: Interpret recent tax developments.

Detailed Syllabus

Unit I:
Taxation concepts; objectives; direct and indirect taxes; principles of taxation; Indian tax system overview; relevance of taxation for business planning and compliance.

Unit II:
GST introduction; features; GST structure; CGST, SGST, IGST; taxable supply; levy and collection; registration requirements; digital business relevance.

Unit III:
GST valuation; input tax credit; place of supply rules; time of supply; invoice requirements; electronic documentation; compliance implications.

Unit IV:
GST returns and payment; GST portal overview; filing procedures; interest and penalties; assessment; audits; compliance management for digital enterprises.

Unit V:
Digital economy taxation issues; e commerce operators; equalization levy; cross border digital transactions; challenges and recent developments in digital taxation.

Text Books

1. Singhania, V. K., & Singhania, K. (2021). *Students' guide to GST*. Taxmann.

2. Datey, V. S. (2020). *Indirect taxes GST*. Taxmann.
3. Girish, A. (2019). *GST simplified*. Commercial Law Publishers.
4. Mehrotra, H. C. (2018). *Indirect taxes*. Sahitya Bhawan.
5. Ahuja, G. K., & Gupta, R. (2020). *Systematic approach to indirect taxes*. Bharat Law House.

Reference Books

1. Bagaria, P. (2019). *GST law and practice*. LexisNexis.
2. CBIC. (2022). *GST manual*. Government of India.
3. OECD. (2020). *Tax challenges arising from digitalisation*. OECD.
4. Jain, S. (2019). *GST ready reckoner*. Taxmann.
5. Rao, K. (2018). *Indian taxation*. PHI Learning.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I

(InsurTech / RegTech / WealthTech)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce technology driven financial service domains.
2. Examine digital transformation in insurance, regulation, and wealth management.
3. Analyze business models of InsurTech, RegTech, and WealthTech.
4. Understand regulatory and risk considerations.
5. Apply elective domain knowledge to financial services.

Course Outcomes

- CO1: Identify key technology driven financial domains.
- CO2: Analyze digital business models in financial services.
- CO3: Understand regulatory and compliance technologies.
- CO4: Evaluate risks and opportunities in FinTech verticals.
- CO5: Apply elective knowledge to real world scenarios.

Detailed Syllabus

Unit I:
Technology enabled financial services overview; InsurTech, RegTech, WealthTech concepts; drivers of innovation; ecosystem participants; relevance for modern financial markets.

Unit II:
InsurTech models; digital insurance platforms; underwriting technologies; claims automation; customer engagement tools; benefits and challenges in insurance digitalization.

Unit III:
RegTech concepts; compliance automation; regulatory reporting tools; KYC and AML technologies; risk monitoring systems; governance implications.

Unit IV:
WealthTech platforms; robo advisory; digital wealth management; portfolio automation; customer profiling; data driven investment advisory services.

Unit V:
Regulatory, ethical, and risk issues; data privacy; cybersecurity; adoption challenges; future trends; integration with traditional financial institutions.

Text Books

1. Nicoletti, B. (2019). *FinTech innovation*. Palgrave Macmillan.
2. Arner, D. W., Barberis, J., & Buckley, R. P. (2020). *The evolution of FinTech*. Oxford University Press.
3. Chishti, S., & Barberis, J. (2016). *The FinTech book*. Wiley.
4. Gomber, P., Koch, J. A., & Siering, M. (2018). *Digital finance*. Springer.
5. Lee, I., & Shin, Y. J. (2018). *FinTech ecosystem*. Business Horizons.

Reference Books

1. Haddad, C., & Hornuf, L. (2019). *The emergence of FinTech*. Small Business Economics.
2. Zavolokina, L., Dolata, M., & Schwabe, G. (2017). *FinTech transformation*. Springer.
3. Philippon, T. (2020). *On FinTech and financial efficiency*. Journal of Finance.
4. Gai, K., Qiu, M., & Sun, X. (2018). *A survey on FinTech*. IEEE Access.
5. Basel Committee. (2021). *Sound practices on FinTech*. BIS.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project : (Digital Commerce / FinTech Case Study)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply theoretical knowledge to practical digital commerce problems.
2. Develop problem identification and analytical skills.
3. Perform data collection and structured analysis.
4. Enhance technical report writing abilities.
5. Prepare for major project and industry engagement.

Course Outcomes

- CO1: Identify suitable digital commerce or FinTech problems.
- CO2: Apply analytical frameworks and tools.
- CO3: Interpret business and financial data.
- CO4: Prepare structured project reports.
- CO5: Present findings professionally.

Project Guidelines

Problem identification, literature survey, methodology selection, analysis or prototype development, periodic reviews, final report submission, presentation and evaluation.

Evaluation Scheme

Continuous Assessment (60%) + Project Evaluation and Viva-Voce (40%)

SEMESTER VI

Corporate Governance & Compliance

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop understanding of corporate governance frameworks.
2. Examine roles of board and stakeholders.
3. Understand compliance and regulatory mechanisms.
4. Analyze ethical dimensions of governance.
5. Enable governance oriented managerial decision making.

Course Outcomes

- CO1: Identify principles of corporate governance.
- CO2: Analyze governance structures and board roles.
- CO3: Interpret compliance and regulatory requirements.
- CO4: Evaluate ethical issues in corporate governance.
- CO5: Apply governance practices in organizational contexts.

Detailed Syllabus

Unit I:
Corporate governance concepts, objectives, principles; evolution of governance practices; stakeholder theory; agency theory; governance models; relevance for corporate accountability and transparency in business organizations.

Unit II:
Board of directors composition; roles and responsibilities; independent directors; audit committee; nomination and remuneration committees; governance mechanisms ensuring oversight and strategic direction.

Unit III:
Corporate governance codes; SEBI regulations; Companies Act provisions; disclosure requirements; compliance reporting; governance rating mechanisms; regulatory framework in Indian corporate environment.

Unit IV:
Corporate ethics; whistleblower mechanisms; corporate social responsibility provisions;

sustainability reporting; ESG considerations; governance role in ethical business conduct and long term value creation.

Unit V:
Governance failures and case studies; risk management linkage; internal controls; compliance challenges; global governance trends; future directions in corporate governance practices.

Text Books

1. Tricker, B. (2019). *Corporate governance* (4th ed.). Oxford University Press.
2. Mallin, C. A. (2020). *Corporate governance* (6th ed.). Oxford University Press.
3. Monks, R. A. G., & Minow, N. (2018). *Corporate governance*. Wiley.
4. Solomon, J. (2020). *Corporate governance and accountability*. Wiley.
5. Fernando, A. C. (2019). *Corporate governance*. Pearson India.

Reference Books

1. OECD. (2015). *G20/OECD principles of corporate governance*. OECD Publishing.
2. Cadbury Committee. (1992). *Report on corporate governance*. Gee.
3. Sharma, J. P. (2018). *Corporate governance, business ethics*. Ane Books.
4. Kumar, A. (2019). *Corporate governance in India*. LexisNexis.
5. Tricker, B. (2015). *Corporate governance principles*. Routledge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Risk Management & Financial Analytics

Course Category: Accounting & Finance Core
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce risk concepts in financial and business contexts.
2. Examine tools for financial risk measurement and control.
3. Apply analytics for risk based decision making.
4. Understand enterprise risk management frameworks.
5. Support strategic and operational risk mitigation.

Course Outcomes

- CO1: Identify types of financial and business risks.
- CO2: Analyze risk using quantitative measures.
- CO3: Apply risk management tools and techniques.
- CO4: Interpret financial analytics for risk decisions.
- CO5: Integrate risk management with business strategy.

Detailed Syllabus

Unit I:
Risk concepts, uncertainty, risk versus return; types of risk, business risk, financial risk; systematic and unsystematic risk; risk perception; importance of risk management in organizations.

Unit II:
Risk measurement techniques; probability concepts; standard deviation; variance; beta coefficient; value at risk concepts; risk assessment models; quantitative evaluation of financial risk exposure.

Unit III:
Financial analytics overview; descriptive and predictive analytics; data sources for risk analysis; analytical tools; interpretation of financial data; analytics driven risk identification and monitoring.

Unit IV:
Risk management tools; hedging techniques; derivatives overview; forwards, futures, options; insurance mechanisms; diversification strategies; application of tools in risk mitigation.

Unit V:
Enterprise risk management frameworks; COSO ERM; regulatory requirements; risk governance; reporting and compliance; emerging risks; integration of analytics with enterprise risk strategy.

Text Books

1. Vaughan, E. J., & Vaughan, T. (2018). *Fundamentals of risk and insurance*. Wiley.
2. Damodaran, A. (2018). *Strategic risk taking*. Pearson.
3. Hull, J. C. (2020). *Risk management and financial institutions*. Wiley.
4. Evans, J. R. (2019). *Business analytics*. Pearson.
5. Hopkin, P. (2018). *Fundamentals of risk management*. Kogan Page.

Reference Books

1. Jorion, P. (2017). *Value at risk*. McGraw Hill.

2. Crouhy, M., Galai, D., & Mark, R. (2019). *Risk management*. McGraw Hill.
3. Basel Committee. (2021). *Principles for financial risk management*. BIS.
4. McNeil, A. J., Frey, R., & Embrechts, P. (2018). *Quantitative risk management*. Princeton.
5. Sharda, R., Delen, D., & Turban, E. (2019). *Business intelligence and analytics*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Emerging Trends in Digital Commerce & FinTech

Course Category: Digital Commerce & Financial Technologies
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Examine emerging technologies shaping digital commerce.
2. Analyze advanced FinTech innovations.
3. Understand platform based digital business models.
4. Assess regulatory and ethical challenges.
5. Prepare for future digital commerce careers.

Course Outcomes

- CO1: Identify emerging trends in digital commerce.
- CO2: Analyze advanced FinTech applications.
- CO3: Evaluate impact of technology on business models.
- CO4: Understand regulatory and ethical implications.
- CO5: Apply trend analysis to strategic planning.

Detailed Syllabus

Unit I:
Emerging digital commerce trends; platform economy; gig economy; data driven business models; role of artificial intelligence and automation in commerce ecosystems.

Unit II:
Advanced FinTech innovations; open banking; API based finance; embedded finance; digital wallets evolution; innovation drivers in financial services.

Unit III:
Artificial intelligence and machine learning applications; chatbots; robo advisory; fraud detection; personalization; analytics driven customer experience enhancement.

Unit IV:
Blockchain, Web3, decentralized finance; tokenization; smart platforms; metaverse commerce; implications for financial systems and digital trade environments.

Unit V:
Regulatory technology trends; ethical challenges; sustainability in digital commerce; future workforce skills; global trends; strategic preparedness for evolving digital economy.

Text Books

1. Gomber, P., Koch, J. A., & Siering, M. (2018). *Digital finance*. Springer.
2. Nicoletti, B. (2019). *FinTech innovation*. Palgrave Macmillan.
3. Chaffey, D. (2020). *Digital business and e commerce management*. Pearson.
4. Arner, D. W., Barberis, J., & Buckley, R. P. (2020). *The evolution of FinTech*. Oxford University Press.
5. Tapscott, D., & Tapscott, A. (2018). *Blockchain revolution*. Portfolio.

Reference Books

1. UNCTAD. (2021). *Digital economy report*. United Nations.
2. OECD. (2020). *Digital transformation*. OECD Publishing.
3. Philippon, T. (2020). *On FinTech and financial efficiency*. Journal of Finance.
4. Schwab, K. (2018). *The fourth industrial revolution*. Crown.
5. McAfee, A., & Brynjolfsson, E. (2017). *Machine, platform, crowd*. Norton.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II (Global Financial Markets / Digital Entrepreneurship)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce global financial market structures or digital entrepreneurship concepts.
2. Examine international investment and startup ecosystems.
3. Analyze market instruments or entrepreneurial models.

4. Understand regulatory and risk environments.
5. Encourage global and entrepreneurial perspectives.

Course Outcomes

- CO1: Understand global markets or digital venture concepts.
- CO2: Analyze instruments or startup models.
- CO3: Evaluate risk and opportunity dynamics.
- CO4: Interpret regulatory environments.
- CO5: Apply elective knowledge to business scenarios.

Detailed Syllabus

Unit I:
Global financial markets overview; capital markets; foreign exchange markets; international investors; alternatively digital entrepreneurship ecosystem; startup fundamentals; innovation driven ventures.

Unit II:
Market instruments; equities, bonds, derivatives; alternatively startup ideation; opportunity identification; value proposition development; market validation techniques.

Unit III:
Market integration; globalization of finance; cross border capital flows; alternatively digital business models; platform startups; scalability and growth strategies.

Unit IV:
Risk and regulation; international financial regulations; market volatility; alternatively startup financing; venture capital; angel investment; funding stages.

Unit V:
Future trends; emerging global markets; fintech integration; alternatively digital entrepreneurship challenges; sustainability; global opportunities; strategic outlook.

Text Books

1. Mishkin, F. S. (2019). *The economics of money, banking and financial markets*. Pearson.
2. Bodie, Z., Kane, A., & Marcus, A. J. (2021). *Investments*. McGraw Hill.
3. Ries, E. (2017). *The lean startup*. Crown Business.
4. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2019). *Entrepreneurship*. McGraw Hill.
5. Hill, C. W. L. (2021). *International business*. McGraw Hill.

Reference Books

1. Krugman, P. R., Obstfeld, M., & Melitz, M. J. (2019). *International economics*. Pearson.
2. Damodaran, A. (2018). *Applied corporate finance*. Wiley.
3. Blank, S. (2019). *The startup owner's manual*. Wiley.
4. Osterwalder, A., & Pigneur, Y. (2018). *Business model generation*. Wiley.
5. UNIDO. (2020). *Entrepreneurship development*. UN.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project (Industry / Research Based)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Apply comprehensive program knowledge to complex problems.
2. Conduct independent industry or research oriented work.
3. Integrate digital commerce and financial technology tools.
4. Demonstrate professional documentation and analysis skills.
5. Prepare for higher studies or professional careers.

Course Outcomes

- CO1: Identify and define complex project problems.
- CO2: Apply appropriate methodologies and tools.
- CO3: Analyze data and derive meaningful insights.
- CO4: Prepare comprehensive technical reports.
- CO5: Defend project work professionally.

Project Guidelines

Problem formulation, literature review, methodology design, implementation or analysis, periodic evaluation, final report submission, project presentation and viva voce.

Evaluation Scheme

Continuous Assessment (60%) + Project Evaluation and Viva-Voce (40%)

Seminar / Viva-Voce

Course Category: Seminar / Viva-Voce Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop professional presentation competence.
2. Enhance articulation of technical and business concepts.
3. Encourage critical review of contemporary topics.
4. Assess conceptual integration across the programme.
5. Prepare for professional evaluation settings.

Course Outcomes

- CO1: Present seminar topics effectively.
- CO2: Demonstrate depth of subject understanding.
- CO3: Respond confidently to evaluative questions.
- CO4: Integrate interdisciplinary knowledge.
- CO5: Exhibit professional communication skills.

Evaluation Scheme

Seminar Presentation (50%) + Viva-Voce Examination (50%)

B.Voc. – Aquaculture Operations & Farm Management

Duration: 3 Years | 6 SEMESTER s | Total Credits: 120

SEMESTER I

Basics of Aquaculture Science

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Establish fundamental concepts of aquaculture systems and practices
2. Develop understanding of culture species and production environments
3. Familiarize scientific principles governing aquaculture operations
4. Introduce classification of aquaculture practices and technologies
5. Build foundation for advanced aquaculture and farm management studies

Course Outcomes

- CO1: Understand scope and importance of aquaculture
- CO2: Classify aquaculture systems and culture practices
- CO3: Identify cultured aquatic organisms and environments
- CO4: Relate biological principles to aquaculture productivity
- CO5: Apply basic aquaculture concepts in farm-level contexts

Detailed Syllabus

Unit I:
Aquaculture definition, scope, history; global and Indian aquaculture status; freshwater, brackish water, marine systems; capture fisheries versus culture fisheries; food security relevance; employment potential; production trends; sustainability perspectives; interdisciplinary linkages with biology, chemistry, engineering.

Unit II:
Aquaculture systems classification; extensive, semi-intensive, intensive culture; monoculture, polyculture, integrated farming; open and closed systems; pond, cage, pen, raceway culture; water resource utilization; infrastructure requirements; scale-based operational characteristics.

Unit III:
Cultivable aquatic organisms; finfish, shellfish, crustaceans, molluscs; freshwater and brackish water species; indigenous and exotic species; species selection criteria; growth patterns; trophic levels; ecological adaptability; production suitability considerations.

Unit IV:
Basic productivity principles; primary and secondary productivity; food chains and food webs; nutrient cycles; plankton role; carrying capacity; biomass estimation; stocking density concepts; yield optimization parameters; environmental interactions in culture systems.

Unit V:
Overview of aquaculture inputs; seed, feed, water, fertilizers; basic farm operations; harvesting principles; risk factors; constraints in aquaculture development; socio-economic considerations; future prospects; technological interventions; policy relevance.

Text Books

1. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
2. Bhatnagar, A., & Devi, P. (2013). *Water quality guidelines for aquaculture*. International Journal of Environmental Sciences.
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices* (2nd ed.). Blackwell.
4. Stickney, R. R. (2009). *Aquaculture: An introductory text* (2nd ed.). CABI.
5. New, M. B. (2010). *Aquaculture: A global perspective*. Wiley-Blackwell.

Reference Books

1. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture: Farming aquatic animals and plants* (2nd ed.). Wiley-Blackwell.
2. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
3. Tacon, A. G. J. (2020). *Feed and feeding practices in aquaculture*. FAO.
4. De Silva, S. S., & Anderson, T. A. (1995). *Fish nutrition in aquaculture*. Springer.
5. Beveridge, M. C. M. (2004). *Cage aquaculture* (3rd ed.). Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Aquatic Biology & Ecology

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand structural and functional organization of aquatic organisms
2. Examine freshwater and marine aquatic ecosystems
3. Analyze ecological interactions in aquatic environments
4. Study biodiversity and adaptation of aquatic life
5. Relate ecological principles to aquaculture productivity

Course Outcomes

- CO1: Describe basic aquatic biological organization
- CO2: Classify aquatic ecosystems and habitats
- CO3: Analyze ecological interactions and energy flow
- CO4: Explain adaptations of aquatic organisms
- CO5: Apply ecological principles to aquaculture systems

Detailed Syllabus

Unit I:
Aquatic biology fundamentals; cellular organization; tissues and organ systems of aquatic organisms; physiological adaptations; osmoregulation mechanisms; metabolic processes; growth patterns; reproduction basics; life cycle strategies; environmental influence on biology.

Unit II:
Aquatic ecosystems; freshwater, brackish water, marine ecosystems; lentic and lotic systems; physical and chemical characteristics; habitat classification; ecosystem productivity; ecological zonation; community structure; ecosystem stability.

Unit III:
Ecological interactions; food chains and food webs; trophic levels; predator prey relationships; competition and symbiosis; population dynamics; carrying capacity; energy transfer efficiency; nutrient cycling processes.

Unit IV:
Aquatic biodiversity; species diversity; genetic diversity; ecosystem diversity; endemic and exotic species; invasive species impacts; conservation significance; biodiversity hotspots; ecological resilience; sustainability considerations.

Unit V:
Ecology and aquaculture linkages; ecosystem based aquaculture; ecological balance; environmental stressors; anthropogenic impacts; climate variability; ecosystem management approaches; conservation oriented aquaculture practices.

Text Books

1. Wetzel, R. G. (2001). *Limnology: Lake and river ecosystems*. Academic Press.
2. Odum, E. P., & Barrett, G. W. (2005). *Fundamentals of ecology*. Cengage Learning.
3. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
4. Stickney, R. R. (2009). *Aquaculture: An introductory text*. CABI.
5. Begon, M., Townsend, C. R., & Harper, J. L. (2006). *Ecology*. Blackwell.

Reference Books

1. Allan, J. D., & Castillo, M. M. (2007). *Stream ecology*. Springer.
2. De Silva, S. S., & Anderson, T. A. (1995). *Fish nutrition in aquaculture*. Springer.
3. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
4. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
5. Moss, B. (2010). *Ecology of freshwaters*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Fundamentals of Fisheries Science

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fisheries science concepts and scope
2. Understand capture and culture fisheries systems
3. Study fishing methods and craft gear technology
4. Analyze fish population dynamics
5. Relate fisheries science to resource management

Course Outcomes

- CO1: Explain fundamentals of fisheries science

- CO2: Differentiate capture and culture fisheries
- CO3: Identify fishing gears and crafts
- CO4: Analyze fish population parameters
- CO5: Apply fisheries concepts to management

Detailed Syllabus

Unit I:
Fisheries science overview; history and scope; inland and marine fisheries; capture fisheries concept; culture fisheries distinction; global and Indian fisheries status; production trends; socio-economic importance.

Unit II:
Fishing crafts; traditional and mechanized crafts; design principles; materials used; operational features; navigation basics; safety aspects; fuel efficiency; environmental considerations in fishing operations.

Unit III:
Fishing gears; nets, lines, traps; gear classification; selectivity principles; mesh size regulations; gear efficiency; operational methods; seasonal variations; impact on fish stocks.

Unit IV:
Fish population dynamics; growth parameters; mortality rates; recruitment; stock assessment basics; sustainable yield concepts; overfishing indicators; conservation measures; management implications.

Unit V:
Fisheries management; regulatory measures; closed seasons; mesh regulations; licensing; community participation; co-management approaches; ecosystem based fisheries management; sustainability principles.

Text Books

1. Lagler, K. F. (1978). *Capture, sampling and examination of fishes*. Wiley.
2. Pillay, T. V. R. (2004). *Aquaculture and fisheries*. Blackwell.
3. King, M. (2007). *Fisheries biology, assessment and management*. Blackwell.
4. FAO. (2011). *Introduction to fisheries science*. FAO.
5. Stickney, R. R. (2009). *Aquaculture*. CABI.

Reference Books

1. Sparre, P., & Venema, S. C. (1998). *Introduction to tropical fish stock assessment*. FAO.

2. Beverton, R. J. H., & Holt, S. J. (1993). *On the dynamics of exploited fish populations*. Springer.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. FAO. (2022). *World fisheries review*. FAO.
5. Jennings, S., Kaiser, M., & Reynolds, J. D. (2001). *Marine fisheries ecology*. Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Water Quality Management

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand water quality parameters relevant to aquaculture
2. Analyze chemical and biological characteristics of water
3. Study water quality monitoring techniques
4. Assess impacts of poor water quality on organisms
5. Apply management practices for water quality control

Course Outcomes

- CO1: Identify key water quality parameters
- CO2: Analyze chemical and biological water properties
- CO3: Monitor water quality using standard methods
- CO4: Assess water quality related stress impacts
- CO5: Implement water quality management practices

Detailed Syllabus

Unit I:
Water quality concepts; physical parameters; temperature, turbidity, transparency; light penetration; seasonal variation; relevance to aquatic productivity; measurement techniques; acceptable ranges for aquaculture systems.

Unit II:
Chemical parameters; dissolved oxygen; carbon dioxide; pH; alkalinity; hardness; nitrogen

compounds; phosphorus dynamics; chemical equilibria; influence on fish physiology and growth.

Unit III:
Biological parameters; plankton communities; primary productivity; bacterial activity; organic matter decomposition; biological oxygen demand; water fertility indicators; ecological balance.

Unit IV:
Water quality monitoring; sampling techniques; field test kits; laboratory analysis; data interpretation; water quality indices; frequency of monitoring; record maintenance.

Unit V:
Water quality management; aeration; liming; fertilization; water exchange; corrective measures; pollution control; effluent management; best management practices in aquaculture.

Text Books

1. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
2. Bhatnagar, A., & Devi, P. (2013). *Water quality guidelines for aquaculture*. Springer.
3. Wetzel, R. G. (2001). *Limnology*. Academic Press.
4. Stickney, R. R. (2009). *Aquaculture*. CABI.
5. APHA. (2017). *Standard methods for the examination of water*. APHA.

Reference Books

1. FAO. (2018). *Water quality management in aquaculture*. FAO.
2. De Silva, S. S., & Anderson, T. A. (1995). *Fish nutrition in aquaculture*. Springer.
3. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
4. Moss, B. (2010). *Ecology of freshwaters*. Wiley-Blackwell.
5. Boyd, C. E. (2015). *Water quality: Pond aquaculture*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Course 5: Farm Tools, Safety & Occupational Practices

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Identify commonly used aquaculture farm tools and equipment

2. Understand operational safety principles in farm environments
3. Apply occupational health practices in aquaculture settings
4. Develop awareness of hazard prevention and risk mitigation
5. Promote safe and sustainable farm working culture

Course Outcomes

- CO1: Identify aquaculture tools and equipment
- CO2: Apply safety measures in farm operations
- CO3: Follow occupational health standards
- CO4: Assess risks and hazards in farm activities
- CO5: Demonstrate safe handling and maintenance practices

List of Experiments / Exercises

1. Identification and handling of basic aquaculture farm tools, including nets, aerators, pumps, and feeding devices, emphasizing correct usage techniques and functional understanding.
2. Demonstration of personal protective equipment usage, including gloves, boots, masks, and safety gear, focusing on occupational health compliance.
3. Practice of safe operation of electrical equipment in wet farm conditions, including risk identification and preventive measures.
4. Maintenance and storage procedures for farm tools, emphasizing longevity, corrosion prevention, and operational safety.
5. Simulation of emergency response for farm accidents, including first aid, reporting protocols, and hazard containment.
6. Identification of biological, chemical, and physical hazards in aquaculture farms, focusing on mitigation strategies.
7. Demonstration of ergonomic practices during lifting, feeding, and harvesting operations to prevent injuries.
8. Waste handling and disposal practices in farms, including safety and environmental considerations.
9. Fire safety drills and handling of basic firefighting equipment in farm environments.
10. Record maintenance for safety audits and occupational compliance documentation.

Expected Outcomes

Safe tool handling skills, occupational safety awareness, hazard prevention capability, compliance with farm safety standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Improve listening, speaking, reading, and writing skills
2. Develop professional communication competence
3. Enhance workplace communication abilities
4. Build confidence in formal and informal interactions
5. Strengthen employability and interpersonal skills

Course Outcomes

- CO1: Communicate effectively in professional contexts
- CO2: Demonstrate functional English proficiency
- CO3: Prepare basic professional documents
- CO4: Participate in workplace interactions confidently
- CO5: Apply communication skills for employability

Detailed Syllabus

Unit I:
Communication process; verbal and non-verbal communication; barriers to communication; listening skills; speaking clarity; pronunciation basics; professional communication context; interpersonal effectiveness.

Unit II:
Reading skills; comprehension techniques; vocabulary development; technical and non-technical texts; skimming and scanning; information extraction; contextual understanding.

Unit III:
Writing skills; sentence structure; paragraph organization; formal correspondence; emails; notices; reports; documentation basics; workplace writing standards.

Unit IV:
Professional speaking; presentations; group discussions; interviews; telephonic communication; confidence building; body language; etiquette; professional demeanor.

Unit V:
Employability skills; teamwork; leadership communication; problem solving discussions; workplace ethics; cross-cultural communication; digital communication platforms; career readiness.

Text Books

1. Raman, M., & Sharma, S. (2011). *Technical communication*. Oxford University Press.
2. Murphy, R. (2016). *English grammar in use*. Cambridge.
3. Bovee, C. L., & Thill, J. V. (2017). *Business communication today*. Pearson.
4. Comfort, J., Revell, R., & Stott, C. (2010). *English for the telecommunications industry*. Oxford.
5. Kumar, S., & Lata, P. (2014). *Communication skills*. Oxford.

Reference Books

1. Lesikar, R. V., Flatley, M. E., & Rentz, K. (2013). *Business communication*. McGraw-Hill.
2. Guffey, M. E., & Loewy, D. (2018). *Essentials of business communication*. Cengage.
3. Bailey, E. P. (2014). *Writing and speaking at work*. Pearson.
4. Sharma, R. C., & Mohan, K. (2015). *Business correspondence and report writing*. Tata McGraw-Hill.
5. Barker, A. (2010). *Improve your communication skills*. Kogan Page.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Field Orientation / Farm Exposure

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to real aquaculture farm environments
2. Observe basic farm operations and management practices
3. Relate classroom learning to field-level applications

4. Develop professional discipline and observational skills
5. Understand farm workflow and occupational practices

Course Outcomes

- CO1: Observe aquaculture farm operations
- CO2: Identify practical constraints in farm management
- CO3: Relate theory to field practices
- CO4: Demonstrate professional conduct in farm settings
- CO5: Prepare basic field observation reports

Guidelines

Farm visits; supervised exposure; observation records; interaction with farm personnel; submission of field diary.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER II

Aquaculture Species Identification & Biology

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand taxonomic classification of aquaculture species
2. Study morphology and anatomy of cultured organisms
3. Analyze biological functions relevant to aquaculture
4. Identify species suitability for culture systems
5. Relate species biology to productivity and management

Course Outcomes

- CO1: Classify major aquaculture species
- CO2: Identify anatomical features of cultured organisms
- CO3: Explain biological functions influencing growth
- CO4: Relate species traits to culture performance
- CO5: Apply biological knowledge to species selection

Detailed Syllabus

Unit I:
Taxonomy and classification principles; nomenclature rules; major groups of cultured finfish, shellfish, crustaceans; freshwater and brackish water species; indigenous and exotic species; identification keys; economic importance; biodiversity relevance.

Unit II:
External morphology of fish and shellfish; body forms; fins, scales, appendages; adaptive features; feeding structures; locomotory adaptations; sexual dimorphism; species-specific identification characteristics.

Unit III:
Internal anatomy; digestive, respiratory, circulatory systems; excretory and nervous systems; physiological functions; metabolic processes; growth and development patterns; relevance to nutrition and health management.

Unit IV:
Reproductive biology; gonadal development; breeding seasons; fecundity; spawning

behavior; larval development stages; recruitment processes; implications for hatchery and seed production.

Unit V:
Species biology and aquaculture performance; growth rates; survival traits; environmental tolerance; disease resistance; carrying capacity; biological limitations; productivity optimization considerations.

Text Books

1. Lagler, K. F., Bardach, J. E., & Miller, R. R. (1977). *Ichthyology*. Wiley.
2. Stickney, R. R. (2009). *Aquaculture: An introductory text*. CABI.
3. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
5. Bond, C. E. (1996). *Biology of fishes*. Saunders.

Reference Books

1. Helfman, G. S., Collette, B. B., & Facey, D. E. (2009). *The diversity of fishes*. Wiley.
2. FAO. (2022). *Species identification sheets*. FAO.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
5. Moyle, P. B., & Cech, J. J. (2004). *Fishes*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Principles of Pond Construction & Farm Layout

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of pond engineering
2. Study site selection and soil characteristics
3. Analyze farm layout planning requirements
4. Examine pond design and construction methods
5. Apply engineering concepts to aquaculture farms

Course Outcomes

- CO1: Identify suitable sites for aquaculture ponds
- CO2: Analyze soil and water resource requirements
- CO3: Design basic pond layouts
- CO4: Apply construction principles practically
- CO5: Plan efficient farm infrastructure

Detailed Syllabus

Unit I:
Pond culture concept; role of ponds in aquaculture; site selection criteria; water availability; topography; accessibility; climatic considerations; environmental suitability; farm planning objectives.

Unit II:
Soil characteristics; soil texture, structure; permeability; clay content; soil testing methods; soil amendments; suitability evaluation; impact on water retention and productivity.

Unit III:
Pond design principles; shape and size; embankments; pond depth; inlet and outlet structures; drainage systems; water control devices; construction materials.

Unit IV:
Farm layout planning; arrangement of ponds; hatchery, nursery, grow-out units; roads and drainage; water supply systems; biosecurity zoning; operational efficiency.

Unit V:
Pond construction methods; excavation; embankment construction; compaction; lining techniques; cost considerations; maintenance requirements; renovation practices.

Text Books

1. Boyd, C. E. (2020). *Water quality*. Springer.
2. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
3. Stickney, R. R. (2009). *Aquaculture*. CABI.
4. FAO. (2010). *Construction of fish ponds*. FAO.
5. Bhatnagar, A., & Devi, P. (2013). *Water quality guidelines*. Springer.

Reference Books

1. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
2. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. FAO. (2018). *Aquaculture engineering*. FAO.

5. Boyd, C. E. (2015). *Pond aquaculture water quality*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Aquaculture Nutrition & Feed Management

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand nutritional requirements of aquatic organisms
2. Study feed ingredients and formulation principles
3. Analyze feeding strategies and feed management
4. Examine feed utilization and efficiency
5. Relate nutrition to growth and health

Course Outcomes

- CO1: Explain nutritional needs of cultured species
- CO2: Identify feed ingredients and supplements
- CO3: Apply feed formulation principles
- CO4: Manage feeding practices efficiently
- CO5: Improve growth and feed conversion

Detailed Syllabus

Unit I:
Principles of fish nutrition; proteins, lipids, carbohydrates; vitamins and minerals; energy requirements; nutrient metabolism; species-specific nutritional needs; growth relationships.

Unit II:
Feed ingredients; plant and animal sources; ingredient quality; digestibility; anti-nutritional factors; ingredient selection criteria; availability and cost considerations.

Unit III:
Feed formulation principles; balanced diet concept; formulation methods; least-cost formulation; pellet types; sinking and floating feeds; feed processing basics.

Unit IV:
Feeding management; feeding rates; frequency; feeding methods; demand feeders; feeding behavior; feed wastage control; feed conversion ratio.

Unit V:
Feed efficiency and sustainability; alternative ingredients; probiotics; nutraceuticals; environmental impacts; feed management challenges; future trends in aquafeeds.

Text Books

1. De Silva, S. S., & Anderson, T. A. (1995). *Fish nutrition*. Springer.
2. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.
3. Stickney, R. R. (2009). *Aquaculture*. CABI.
4. NRC. (2011). *Nutrient requirements of fish*. National Academies.
5. Pillay, T. V. R. (2004). *Aquaculture*. Blackwell.

Reference Books

1. FAO. (2017). *Aquafeed sustainability*. FAO.
2. Boyd, C. E. (2020). *Water quality*. Springer.
3. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
4. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.
5. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Soil & Water Chemistry for Aquaculture

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand soil chemical properties influencing aquaculture productivity
2. Study water chemistry parameters relevant to cultured systems
3. Analyze nutrient cycling in soil and water environments
4. Interpret soil and water analytical data
5. Apply chemistry-based management practices in aquaculture

Course Outcomes

- CO1: Identify soil and water chemical characteristics
- CO2: Analyze nutrient dynamics in aquaculture systems

- CO3: Interpret soil and water quality data
- CO4: Apply corrective chemical management measures
- CO5: Maintain productive and sustainable culture environments

Detailed Syllabus

Unit I:
Soil chemistry fundamentals; soil formation processes; soil texture and structure classification; soil pH behavior; organic matter composition; cation exchange capacity; nutrient retention mechanisms; soil fertility relevance; influence on aquaculture pond productivity.

Unit II:
Water chemistry principles; molecular structure of water; ionic composition; salinity regimes; alkalinity and hardness relationships; buffering capacity; dissolved ions; chemical equilibria; water quality stability; implications for aquatic organism survival.

Unit III:
Nutrient dynamics in aquaculture systems; nitrogen cycle transformations; ammonia, nitrite, nitrate behavior; phosphorus cycle; sediment nutrient exchange; microbial mediation; toxicity thresholds; productivity relationships; environmental loading effects.

Unit IV:
Soil and water analysis techniques; representative sampling methods; laboratory analytical procedures; field testing kits; interpretation of analytical results; soil and water quality indices; threshold values; decision-making relevance.

Unit V:
Soil and water management practices; liming strategies; fertilization methods; water treatment options; soil conditioning techniques; pollution prevention; environmental impact mitigation; sustainable soil and water management frameworks.

Text Books

1. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
2. Wetzel, R. G. (2001). *Limnology: Lake and river ecosystems*. Academic Press.
3. Bhatnagar, A., & Devi, P. (2013). *Water quality guidelines for aquaculture*. Springer.
4. Brady, N. C., & Weil, R. R. (2017). *The nature and properties of soils*. Pearson.
5. Stickney, R. R. (2009). *Aquaculture: An introductory text*. CABI.

Reference Books

1. Boyd, C. E. (2015). *Water quality: Pond aquaculture*. Springer.
2. FAO. (2018). *Water quality management in aquaculture*. FAO.

3. De Silva, S. S., & Anderson, T. A. (1995). *Fish nutrition in aquaculture*. Springer.
4. Moss, B. (2010). *Ecology of freshwaters*. Wiley-Blackwell.
5. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Introduction to Farm Accounting & Records

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce accounting concepts relevant to aquaculture farms
2. Develop skills in farm record maintenance
3. Analyze costs and financial performance of farm operations
4. Interpret basic financial statements
5. Support informed financial decision-making in farms

Course Outcomes

- CO1: Understand basic farm accounting concepts
- CO2: Maintain systematic farm records
- CO3: Analyze farm costs and profitability
- CO4: Interpret financial statements
- CO5: Apply accounting information for farm decisions

Detailed Syllabus

Unit I:
Farm accounting fundamentals; objectives and scope; importance in aquaculture enterprises; basic accounting terminology; assets and liabilities classification; income and expenditure concepts; cash and accrual accounting principles; farm relevance.

Unit II:
Farm records management; production records; input usage records; labor and wage records; inventory management; record formats; accuracy requirements; data consistency; role of records in planning and control.

Unit III:
Cost accounting principles; fixed and variable costs; direct and indirect costs; depreciation

methods; cost classification; budgeting concepts; cost control mechanisms; profitability measurement indicators.

Unit IV:
Financial statements preparation; income statement components; balance sheet structure; cash flow statements; interpretation techniques; liquidity and solvency indicators; financial performance evaluation; farm viability assessment.

Unit V:
Use of accounting information; farm planning and control decisions; loan and credit applications; repayment scheduling; taxation basics; digital accounting systems; statutory compliance; transparency and accountability.

Text Books

1. Jolly, C. M., & Clonts, H. A. (1993). *Economics of aquaculture*. Food Products Press.
2. Kay, R. D., Edwards, W. M., & Duffy, P. A. (2012). *Farm management*. McGraw-Hill.
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
4. Gupta, R. L., & Radhaswamy, M. (2017). *Advanced accounting*. Sultan Chand.
5. Singh, S. (2018). *Agricultural finance and farm management*. Kalyani.

Reference Books

1. FAO. (2017). *Farm management extension guide*. FAO.
2. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). *Entrepreneurship*. McGraw-Hill.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Scarborough, N. M., & Cornwall, J. R. (2016). *Small business management*. Pearson.
5. OECD. (2016). *Rebuilding fisheries and aquaculture*. OECD.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Innovation in Aquaculture

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce design thinking principles for aquaculture problems
2. Encourage innovative problem-solving approaches

3. Develop creativity and idea generation skills
4. Apply innovation concepts to farm-level challenges
5. Promote sustainable and scalable aquaculture solutions

Course Outcomes

- CO1: Understand design thinking frameworks
- CO2: Generate innovative solutions for aquaculture issues
- CO3: Apply prototyping and testing approaches
- CO4: Integrate innovation into farm practices
- CO5: Evaluate impact and scalability of innovations

Detailed Syllabus

Unit I:
Design thinking fundamentals; innovation concepts; problem identification techniques; user-centered approach; empathy mapping; need assessment; relevance to aquaculture operational challenges; creative mindset development.

Unit II:
Idea generation processes; brainstorming methods; creative thinking tools; lateral thinking; opportunity identification; feasibility screening; innovation culture development; collaborative ideation practices.

Unit III:
Prototyping concepts; low-cost solution modeling; pilot testing approaches; experimentation methods; feedback collection; iteration cycles; refinement processes; learning from failures.

Unit IV:
Innovation applications in aquaculture; technology adoption pathways; farm-level process innovations; product and service innovations; operational efficiency improvements; case-based illustrations.

Unit V:
Entrepreneurial innovation; scaling innovative ideas; sustainability orientation; social and environmental impact assessment; risk considerations; future innovation trends in aquaculture enterprises.

Text Books

1. Brown, T. (2009). *Change by design*. Harper Business.
2. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley.
3. Scarborough, N. M., & Cornwall, J. R. (2016). *Essentials of entrepreneurship*. Pearson.

4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
5. FAO. (2019). *Innovation in aquaculture*. FAO.

Reference Books

1. IDEO. (2015). *The field guide to human-centered design*. IDEO.
2. Drucker, P. F. (2014). *Innovation and entrepreneurship*. Routledge.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. OECD. (2018). *Innovation, productivity and sustainability*. OECD.
5. Tidd, J., & Bessant, J. (2018). *Managing innovation*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship / Farm Attachment

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Apply SEMESTER II concepts in real farm environments
2. Observe pond preparation, feeding, and routine management
3. Maintain basic farm operational records
4. Develop discipline, teamwork, and professional conduct
5. Gain familiarity with seasonal aquaculture activities

Course Outcomes

- CO1: Demonstrate practical exposure to aquaculture operations
- CO2: Relate nutrition, soil, and water concepts to practice
- CO3: Maintain basic farm and cost records
- CO4: Follow farm discipline and safety protocols
- CO5: Prepare structured internship reports

Guidelines
Farm attachment under supervision; task observation; record maintenance; interaction with farm staff; submission of internship report.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER III

Freshwater & Brackish Water Aquaculture

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand principles of freshwater and brackish water aquaculture systems
2. Study species suitability under varying salinity conditions
3. Analyze culture practices and management strategies
4. Examine production cycles and yield optimization methods
5. Develop operational competence for inland and coastal aquaculture

Course Outcomes

- CO1: Differentiate freshwater and brackish water aquaculture systems
- CO2: Identify species suitable for different salinity regimes
- CO3: Apply appropriate culture and management practices
- CO4: Analyze production constraints and performance
- CO5: Plan basic freshwater and brackish water farming operations

Detailed Syllabus

Unit I:
Freshwater aquaculture concepts; inland water resources; pond, tank, reservoir culture systems; carp and catfish culture; composite fish culture principles; species compatibility; stocking density norms; productivity patterns; regional production trends.

Unit II:
Brackish water aquaculture fundamentals; estuarine and coastal ecosystems; salinity gradients; shrimp, crab, and brackish water finfish culture; site selection criteria; soil and water considerations; seasonal variability influences.

Unit III:
Culture management practices; pond preparation techniques; liming and fertilization schedules; stocking methods; feeding strategies; water quality monitoring; routine farm operations; growth assessment procedures.

Unit IV:
Harvesting and post-harvest handling; partial and complete harvesting methods; harvesting

gears; handling stress reduction; yield optimization; crop duration; multiple cropping concepts; economic implications.

Unit V:
Constraints and sustainability issues; disease risks; environmental stress factors; salinity fluctuations; climate variability impacts; regulatory considerations; technological interventions; best management practices; future prospects.

Text Books

1. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices*. Blackwell.
2. Stickney, R. R. (2009). *Aquaculture: An introductory text*. CABI.
3. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
4. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
5. New, M. B. (2010). *Aquaculture: A global perspective*. Wiley-Blackwell.

Reference Books

1. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
2. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Tacon, A. G. J. (2020). *Feed and feeding practices in aquaculture*. FAO.
5. Bhatnagar, A., & Devi, P. (2013). *Water quality guidelines for aquaculture*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Hatchery Operations & Seed Production

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand hatchery systems and infrastructure requirements
2. Study broodstock management and breeding techniques
3. Analyze larval rearing and nursery practices
4. Examine seed quality assessment and handling
5. Develop competence in hatchery operations management

Course Outcomes

- CO1: Identify hatchery systems and components
- CO2: Apply broodstock and breeding management practices
- CO3: Manage larval and nursery rearing operations
- CO4: Assess quality of seed produced
- CO5: Plan basic hatchery operational activities

Detailed Syllabus

Unit I:
Hatchery concepts and significance; types of hatcheries; infrastructure components; water supply and treatment; broodstock selection criteria; broodstock nutrition; conditioning methods; reproductive physiology relevance.

Unit II:
Breeding techniques; natural and induced breeding methods; hormonal preparations; dosage determination; spawning techniques; fertilization process; egg collection; incubation systems; hatching success indicators.

Unit III:
Larval rearing practices; larval physiology; live feed organisms; phytoplankton and zooplankton culture; feeding schedules; stocking density management; water quality control; survival enhancement methods.

Unit IV:
Seed production systems; carp hatcheries; shrimp and finfish hatcheries; nursery rearing practices; grading methods; packing and transportation; seed quality parameters; certification standards.

Unit V:
Hatchery management issues; disease risks; biosecurity measures; water treatment; waste management; manpower requirements; operational economics; sustainability and technological advancements.

Text Books

1. Bhowmick, R. M., & Jana, R. K. (2014). *Fish hatchery management*. Narendra Publishing.
2. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
3. Stickney, R. R. (2009). *Aquaculture*. CABI.
4. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
5. FAO. (2017). *Hatchery culture of fishes*. FAO.

Reference Books

1. FAO. (2018). *Seed quality and certification in aquaculture*. FAO.
2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. Boyd, C. E. (2020). *Water quality*. Springer.
5. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Fish Health Management & Disease Control

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand health and stress concepts in aquaculture
2. Identify major diseases affecting cultured species
3. Study diagnostic and preventive health practices
4. Analyze treatment and control measures
5. Promote biosecure aquaculture management

Course Outcomes

- CO1: Identify disease symptoms and stress indicators
- CO2: Classify aquaculture pathogens
- CO3: Apply basic disease diagnostic methods
- CO4: Implement preventive and control strategies
- CO5: Practice biosecurity in aquaculture farms

Detailed Syllabus

Unit I:
Fish health concepts; health indicators; stress physiology; environmental, nutritional, and handling stressors; immune response mechanisms; susceptibility factors; interaction between stress and disease occurrence.

Unit II:
Aquaculture pathogens; bacterial, viral, fungal, parasitic diseases; transmission routes; life cycles of pathogens; host–pathogen interactions; disease epidemiology; outbreak patterns.

Unit III:
Disease diagnosis techniques; clinical signs observation; sampling methods; microscopic examination; basic laboratory diagnostics; water quality linkage; disease confirmation procedures.

Unit IV:
Disease prevention strategies; pond hygiene; water quality management; stocking density regulation; nutrition management; immunostimulants; vaccination concepts; health monitoring programs.

Unit V:
Disease treatment and control; therapeutants and chemicals; dosage principles; application methods; withdrawal periods; resistance concerns; farm biosecurity protocols; health management planning.

Text Books

1. Roberts, R. J. (2012). *Fish pathology*. Wiley-Blackwell.
2. Noga, E. J. (2010). *Fish disease: Diagnosis and treatment*. Wiley-Blackwell.
3. Austin, B., & Austin, D. A. (2012). *Bacterial fish pathogens*. Springer.
4. Woo, P. T. K., & Bruno, D. W. (2011). *Fish diseases and disorders*. CABI.
5. Stickney, R. R. (2009). *Aquaculture*. CABI.

Reference Books

1. FAO. (2017). *Aquaculture biosecurity*. FAO.
2. Plumb, J. A., & Hanson, L. A. (2011). *Health maintenance of fishes*. Wiley.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Boyd, C. E. (2020). *Water quality*. Springer.
5. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Aquaculture Engineering & Farm Mechanization

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand engineering structures used in aquaculture farms
2. Study mechanized systems and farm machinery
3. Analyze aeration and water management systems
4. Examine energy use and efficiency in farms
5. Apply mechanization for improved farm operations

Course Outcomes

- CO1: Identify aquaculture engineering components
- CO2: Operate basic farm machinery
- CO3: Apply aeration and pumping systems
- CO4: Assess mechanization efficiency
- CO5: Improve operational productivity

Detailed Syllabus

Unit I:
Aquaculture engineering overview; farm structures; ponds, tanks, raceways; construction materials; functional design considerations; durability requirements; maintenance needs; layout integration.

Unit II:
Water supply and drainage systems; pumps and pumping mechanisms; flow rate calculations; pipelines and fittings; inlet and outlet structures; energy requirements; operational safety measures.

Unit III:
Aeration systems; paddle wheel aerators; diffused aeration techniques; oxygen transfer efficiency; placement strategies; power consumption; performance evaluation criteria.

Unit IV:
Farm mechanization tools; feeding machines; harvesting equipment; grading devices; automation basics; labor efficiency improvement; cost implications; safety considerations.

Unit V:
Energy management in aquaculture; renewable energy applications; solar-powered aeration; fuel efficiency; maintenance scheduling; mechanization constraints; sustainability aspects.

Text Books

1. Boyd, C. E. (2020). *Water quality*. Springer.
2. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
3. Stickney, R. R. (2009). *Aquaculture*. CABI.
4. FAO. (2018). *Aquaculture engineering*. FAO.
5. Badiola, M., Mendiola, D., & Bostock, J. (2012). *Recirculating aquaculture systems*. FAO.

Reference Books

1. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
2. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Boyd, C. E. (2015). *Pond aquaculture water quality*. Springer.
5. FAO. (2022). *Aquaculture technologies*. FAO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Post-Harvest Handling & Quality Control

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand post-harvest spoilage and quality loss mechanisms
2. Study handling and preservation methods
3. Analyze quality control techniques
4. Examine hygiene and food safety standards
5. Improve shelf life and product quality

Course Outcomes

- CO1: Identify causes of post-harvest losses
- CO2: Apply proper handling and preservation methods
- CO3: Assess quality of harvested products
- CO4: Follow hygiene and safety standards

- CO5: Implement quality control systems

Detailed Syllabus

Unit I:
Post-harvest handling concepts; spoilage mechanisms; biochemical changes; microbial activity; freshness indicators; handling stress effects; importance of rapid preservation.

Unit II:
Preservation techniques; icing methods; chilling and freezing principles; temperature control; onboard handling; landing center practices; shelf-life enhancement methods.

Unit III:
Quality assessment methods; sensory evaluation; physical and chemical indicators; freshness indices; grading standards; quality monitoring procedures.

Unit IV:
Hygiene and sanitation; personal hygiene; equipment sanitation; processing environment control; contamination prevention; food safety principles; regulatory requirements.

Unit V:
Quality standards and systems; national and international standards; HACCP concepts; traceability systems; compliance requirements; quality assurance frameworks.

Text Books

1. Huss, H. H. (1995). *Quality and quality changes in fresh fish*. FAO.
2. Balachandran, K. K. (2014). *Post-harvest technology of fish*. Daya Publishing.
3. FAO. (2018). *Fish handling and preservation*. FAO.
4. Connell, J. J. (1995). *Control of fish quality*. Fishing News Books.
5. Stickney, R. R. (2009). *Aquaculture*. CABI.

Reference Books

1. FAO. (2022). *Seafood safety*. FAO.
2. Boyd, C. E. (2020). *Water quality*. Springer.
3. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
4. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
5. ISO. (2018). *Food safety management systems*. ISO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Rural Development / Environmental Ethics)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand rural development concepts and frameworks
2. Study institutional mechanisms for rural development
3. Examine environmental ethics and sustainability principles
4. Analyze social responsibility in aquaculture
5. Promote ethical and inclusive development approaches

Course Outcomes

- CO1: Explain rural development concepts
- CO2: Identify rural institutions and programs
- CO3: Apply environmental ethics principles
- CO4: Analyze social impacts of aquaculture
- CO5: Promote sustainable and ethical practices

Detailed Syllabus

Unit I:
Rural development concepts; rural economy structure; livelihood systems; agriculture and aquaculture linkages; poverty alleviation role; inclusive growth perspectives.

Unit II:
Institutions in rural development; Panchayati Raj system; cooperatives; self-help groups; extension services; community participation mechanisms.

Unit III:
Environmental ethics foundations; human–environment relationship; ethical frameworks; stewardship concepts; sustainability principles; intergenerational equity.

Unit IV:
Environmental issues; pollution; biodiversity loss; climate change impacts; ethical responsibilities; conservation approaches; community awareness.

Unit V:
Ethics in aquaculture; responsible farming practices; social accountability; community welfare; sustainable development goals alignment.

Text Books

1. Chambers, R. (2014). *Rural development*. Routledge.

2. Desai, V. (2012). *Rural development*. Himalaya Publishing.
3. Singer, P. (2011). *Practical ethics*. Cambridge.
4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
5. FAO. (2019). *Responsible aquaculture*. FAO.

Reference Books

1. FAO. (2022). *Sustainable aquaculture*. FAO.
2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. OECD. (2018). *Innovation and sustainability*. OECD.
4. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
5. UNEP. (2016). *Environmental ethics*. UNEP.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Apply Semester III knowledge in real farm environments
2. Observe hatchery, health, and mechanization practices
3. Assist in routine aquaculture operations
4. Maintain systematic field records
5. Develop professional discipline and work ethics

Course Outcomes

- CO1: Demonstrate practical aquaculture skills
- CO2: Assist in hatchery and farm operations
- CO3: Apply health and management practices
- CO4: Maintain operational records
- CO5: Prepare structured internship reports

Guidelines

Supervised industry or farm attachment; task participation; observation logs; record submission; performance assessment.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER IV

Mariculture & Coastal Aquaculture

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand principles and scope of mariculture systems
2. Analyze coastal resources for aquaculture utilization
3. Study culture practices of marine organisms
4. Examine environmental and regulatory aspects
5. Develop operational competence in coastal aquaculture

Course Outcomes

- CO1: Classify mariculture systems and coastal resources
- CO2: Identify marine species suitable for culture
- CO3: Apply mariculture production practices
- CO4: Assess environmental impacts and constraints
- CO5: Plan basic coastal aquaculture operations

Detailed Syllabus

Unit I:
Mariculture concepts and scope; coastal aquaculture systems; marine resource distribution; nearshore and offshore farming; physical and chemical characteristics of coastal waters; socio-economic importance; national mariculture potential; production trends.

Unit II:
Marine finfish culture; species selection criteria; cage culture systems; site selection parameters; cage design and materials; mooring arrangements; stocking density; feeding management; growth monitoring.

Unit III:
Shellfish culture practices; shrimp, crab, oyster, mussel farming; hatchery dependence; nursery rearing; raft, rack, longline methods; environmental requirements; productivity considerations; culture risks.

Unit IV:
Seaweed and other marine organism culture; agar and carrageenan yielding species;

cultivation techniques; farm layout; harvesting practices; post-harvest handling; utilization pathways; commercial relevance.

Unit V:
Constraints and sustainability issues; coastal regulation norms; environmental impacts; disease risks; climate variability; pollution effects; biosecurity measures; technological interventions; future prospects.

Text Books

1. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices*. Blackwell.
2. Stickney, R. R. (2009). *Aquaculture: An introductory text*. CABI.
3. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
4. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
5. New, M. B. (2010). *Aquaculture: A global perspective*. Wiley-Blackwell.

Reference Books

1. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
2. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Tacon, A. G. J. (2020). *Feed and feeding practices in aquaculture*. FAO.
5. Bhatnagar, A., & Devi, P. (2013). *Water quality guidelines for aquaculture*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Integrated Farming Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of integrated farming systems
2. Study aquaculture integration with agriculture and livestock
3. Analyze nutrient recycling and waste utilization
4. Evaluate productivity and sustainability benefits
5. Develop planning skills for integrated farm models

Course Outcomes

- CO1: Explain integrated farming concepts
- CO2: Identify suitable integration models
- CO3: Apply nutrient recycling principles
- CO4: Assess productivity and economic benefits
- CO5: Design basic integrated farm layouts

Detailed Syllabus

Unit I:
Integrated farming concepts; historical development; aquaculture-based integration; nutrient flow mechanisms; system components; productivity enhancement; sustainability relevance; smallholder suitability.

Unit II:
Fish–livestock integration systems; fish–poultry, fish–duck, fish–pig models; housing requirements; waste utilization; nutrient enrichment; stocking strategies; management considerations.

Unit III:
Fish–agriculture integration; rice–fish farming; horticulture integration; irrigation linkages; crop residue utilization; pest control benefits; ecological interactions; yield improvement.

Unit IV:
Integrated farm management; water management; feed optimization; disease prevention; labor utilization; record keeping; risk management; seasonal planning; economic evaluation.

Unit V:
Constraints and adoption challenges; environmental limitations; socio-economic factors; policy support; extension services; climate resilience; future prospects of integrated farming.

Text Books

1. Edwards, P., Pullin, R. S. V., & Gartner, J. A. (1988). *Integrated crop–livestock–fish farming systems*. ICLARM.
2. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
3. Boyd, C. E. (2020). *Water quality*. Springer.
4. Stickney, R. R. (2009). *Aquaculture*. CABI.
5. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.

Reference Books

1. FAO. (2017). *Integrated agriculture–aquaculture*. FAO.

2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.
5. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Biosecurity & Best Management Practices

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand biosecurity principles in aquaculture
2. Study disease prevention and control strategies
3. Analyze best management practices for farms
4. Examine certification and compliance requirements
5. Promote sustainable and responsible aquaculture

Course Outcomes

- CO1: Identify biosecurity risks and pathways
- CO2: Apply preventive health management practices
- CO3: Implement best management practices
- CO4: Understand certification and compliance norms
- CO5: Promote sustainable aquaculture operations

Detailed Syllabus

Unit I:
Biosecurity concepts; importance in aquaculture; disease introduction pathways; risk assessment; farm zoning; sanitation measures; movement control; biosecurity planning frameworks.

Unit II:
Preventive health management; water quality maintenance; stocking density regulation; feed management; stress reduction; surveillance programs; early warning indicators.

Unit III:
Best management practices; pond preparation; routine management protocols; waste management; effluent control; resource optimization; environmental stewardship.

Unit IV:
Certification standards; best aquaculture practices; eco-labeling; documentation requirements; audit procedures; compliance assessment; farm-level implementation.

Unit V:
Sustainability and compliance challenges; climate risks; disease emergence; regulatory updates; technological support; continuous improvement approaches; future directions.

Text Books

1. FAO. (2017). *Aquaculture biosecurity*. FAO.
2. Boyd, C. E. (2020). *Water quality*. Springer.
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
4. Stickney, R. R. (2009). *Aquaculture*. CABI.
5. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.

Reference Books

1. FAO. (2022). *Responsible aquaculture*. FAO.
2. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.
5. OECD. (2016). *Rebuilding fisheries and aquaculture*. OECD.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Aquaculture Extension & Advisory Services

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand aquaculture extension systems
2. Study communication methods for advisory services
3. Analyze farmer education and training approaches

4. Examine ICT tools in extension delivery
5. Strengthen advisory and capacity-building skills

Course Outcomes

- CO1: Explain extension concepts and systems
- CO2: Apply communication methods in advisory services
- CO3: Organize farmer training programs
- CO4: Use ICT tools for extension delivery
- CO5: Support farmer decision-making processes

Detailed Syllabus

Unit I:
Extension education concepts; objectives; principles; aquaculture extension systems; public and private extension; role of advisory services; stakeholder participation.

Unit II:
Communication methods; individual, group, mass approaches; demonstrations; training programs; field days; exposure visits; effectiveness assessment.

Unit III:
Farmer education and capacity building; training needs assessment; curriculum development; participatory approaches; skill development strategies.

Unit IV:
ICT in extension; mobile advisory services; digital platforms; decision support tools; information dissemination; feedback mechanisms.

Unit V:
Extension challenges; adoption barriers; gender considerations; market-led extension; sustainability orientation; future trends in aquaculture advisory services.

Text Books

1. Swanson, B. E., Bentz, R. P., & Sofranko, A. J. (1997). *Improving agricultural extension*. FAO.
2. Ray, G. L. (2010). *Extension communication*. Oxford.
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
4. FAO. (2019). *Aquaculture extension manual*. FAO.
5. Rogers, E. M. (2003). *Diffusion of innovations*. Free Press.

Reference Books

1. FAO. (2022). *Capacity development in aquaculture*. FAO.

2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.
4. OECD. (2018). *Innovation and sustainability*. OECD.
5. World Bank. (2017). *ICT in agriculture*. World Bank.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I: Ornamental Fish Culture

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand scope and importance of ornamental fish culture
2. Study biology and identification of ornamental fish species
3. Analyze system design and management practices
4. Examine breeding, rearing, and health management aspects
5. Evaluate economics and sustainability of ornamental fish enterprises

Course Outcomes

- CO1: Identify major ornamental fish species and their characteristics
- CO2: Understand ornamental fish culture systems and infrastructure
- CO3: Apply breeding and rearing management practices
- CO4: Analyze health management and quality maintenance
- CO5: Evaluate economic viability and sustainability of ornamental fish culture

Detailed Syllabus

Unit I:
Ornamental fish culture overview; scope and significance; global and Indian trade status; freshwater and marine ornamentals; aesthetic and economic value; role in livelihood generation; hobby and commercial perspectives; industry structure; market trends.

Unit II:
Ornamental fish biology and identification; major freshwater species; livebearers, egg layers; marine ornamental groups; coloration patterns; morphological traits; habitat preferences; behavior characteristics; selection criteria for culture suitability.

Unit III:
Culture systems and infrastructure; aquarium systems; glass, acrylic tanks; filtration units; aeration methods; lighting requirements; water quality parameters; stocking density norms; system maintenance practices; biosecurity considerations.

Unit IV:
Breeding and rearing practices; natural and induced breeding; spawning substrates; broodstock conditioning; larval rearing techniques; live feeds; feeding schedules; growth management; health care; disease prevention measures.

Unit V:
Economics and sustainability; cost components; small-scale enterprise models; input–output analysis; marketing channels; packaging and transportation; export potential; environmental sustainability; ethical trade practices; future prospects.

Text Books

1. Axelrod, H. R., Burgess, W. E., Pronek, N., & Walls, J. G. (2011). *Dr. Axelrod's atlas of freshwater aquarium fishes*. TFH Publications.
2. Andrews, C. (2010). *An interpet guide to aquarium fishes*. Interpet Publishing.
3. Swainson, G. (2013). *Keeping and breeding aquarium fishes*. Blandford Press.
4. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture: Farming aquatic animals and plants*. Wiley-Blackwell.
5. FAO. (2019). *Ornamental fish trade and culture*. FAO.

Reference Books

1. Tlusty, M. (2002). *The benefits and risks of aquacultural production for the aquarium trade*. Aquaculture.
2. Andrews, C., Exell, A., & Carrington, N. (1988). *The manual of fish health*. Salamander Books.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
5. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Aquaculture Operations Laboratory

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop hands-on skills in aquaculture operations
2. Apply farm management techniques practically
3. Perform routine monitoring tasks
4. Handle equipment safely
5. Integrate theory with practice

Course Outcomes

- CO1: Perform basic aquaculture operations
- CO2: Monitor water quality and farm conditions
- CO3: Operate farm equipment effectively
- CO4: Follow safety and biosecurity protocols
- CO5: Record and interpret operational data

List of Experiments / Exercises

1. Pond preparation practices including drying, liming, fertilization, emphasizing procedural accuracy and resource optimization.
2. Measurement of water quality parameters using field kits, interpretation of results, corrective actions identification.
3. Stocking density calculation and acclimatization practices for cultured species under farm conditions.
4. Feed ration calculation and feeding management using manual and mechanized methods.
5. Operation and maintenance of aeration systems focusing on efficiency and safety.
6. Growth sampling techniques, length–weight measurement, biomass estimation procedures.
7. Harvesting methods using appropriate gears, stress reduction, and handling techniques.
8. Post-harvest icing and short-term storage maintaining quality standards.
9. Farm record maintenance for daily operations and production monitoring.

10. Biosecurity and sanitation practices within farm premises.
11. Identification and troubleshooting of common farm operational problems.
12. Safety drills and emergency response during farm operations.

Expected Outcomes

Operational competence, equipment handling skills, data recording ability, safety compliance, integration of theory and practice.

Evaluation Scheme

Continuous Assessment (60%) + End-Semester Practical Examination (40%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Apply Semester IV knowledge in field environments
2. Observe mariculture and integrated farming practices
3. Assist in routine farm operations
4. Maintain systematic field records
5. Develop professional competence

Course Outcomes

- CO1: Demonstrate field-level operational skills
- CO2: Apply biosecurity and management practices
- CO3: Assist in production activities
- CO4: Maintain internship records
- CO5: Prepare structured internship report

Guidelines
Industry orientation through visits, interaction sessions, supervised exposure; documentation of learning activities; adherence to institutional guidelines.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER V

Farm Management & Entrepreneurship in Aquaculture

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand principles of farm management in aquaculture enterprises
2. Develop entrepreneurial competencies for aquaculture ventures
3. Analyze planning, organization, and control of farm operations
4. Study financial, risk, and resource management practices
5. Promote self-employment and enterprise development

Course Outcomes

- CO1: Apply farm management principles to aquaculture
- CO2: Analyze resources and operational efficiency
- CO3: Evaluate financial and risk aspects of farms
- CO4: Prepare basic aquaculture enterprise plans
- CO5: Demonstrate entrepreneurial decision-making skills

Detailed Syllabus

Unit I:
Farm management concepts; scope and objectives; aquaculture farm organization; planning processes; resource identification; land, water, labor management; production planning; operational scheduling; efficiency indicators; managerial decision framework.

Unit II:
Entrepreneurship fundamentals; entrepreneurial characteristics; opportunity identification; aquaculture enterprise types; small, medium, large-scale ventures; innovation orientation; startup ecosystem; institutional support mechanisms; government schemes.

Unit III:
Financial management in farms; capital investment; fixed and variable costs; depreciation methods; cost–benefit analysis; break-even analysis; cash flow statements; profitability indicators; financial feasibility assessment.

Unit IV:
Risk and uncertainty management; production risks; market risks; disease and climate risks;

insurance schemes; diversification strategies; contingency planning; record-based decision support systems.

Unit V:
Human resource management; labor planning; skill development; leadership and supervision; marketing linkages; value chain integration; scaling strategies; sustainability considerations; ethical entrepreneurship practices.

Text Books

1. Jolly, C. M., & Clonts, H. A. (1993). *Economics of aquaculture*. Food Products Press.
2. Kay, R. D., Edwards, W. M., & Duffy, P. A. (2012). *Farm management*. McGraw-Hill.
3. Scarborough, N. M., & Cornwall, J. R. (2016). *Essentials of entrepreneurship*. Pearson.
4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
5. FAO. (2017). *Small-scale aquaculture*. FAO.

Reference Books

1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). *Entrepreneurship*. McGraw-Hill.
2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. OECD. (2016). *Rebuilding fisheries and aquaculture*. OECD.
5. Tacon, A. G. J. (2020). *Feed and feeding practices in aquaculture*. FAO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Aquaculture Economics & Marketing

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand economic principles applied to aquaculture
2. Analyze production economics and cost structures
3. Study market systems and price mechanisms
4. Examine marketing channels for aquatic products

5. Support economic decision-making in farm operations

Course Outcomes

- CO1: Apply economic concepts to aquaculture production
- CO2: Analyze cost and return structures
- CO3: Understand aquaculture market dynamics
- CO4: Evaluate marketing channels and strategies
- CO5: Support farm-level economic decisions

Detailed Syllabus

Unit I:
Economic fundamentals; demand and supply; elasticity concepts; production functions; input–output relationships; aquaculture production economics; efficiency measures; economies of scale; resource allocation principles.

Unit II:
Cost concepts; fixed, variable, total, average, marginal costs; cost curves; short-run and long-run analysis; farm-level cost estimation; profitability indicators.

Unit III:
Market structures; perfect competition; monopoly characteristics; price determination; role of intermediaries; price fluctuations; market information systems; government interventions.

Unit IV:
Marketing channels; farm gate, wholesale, retail markets; cooperative marketing; contract farming; cold chain logistics; transportation systems; storage infrastructure; quality considerations.

Unit V:
Marketing strategies; product differentiation; value addition; branding; export orientation; market risks; consumer preferences; digital marketing tools; policy environment.

Text Books

1. Jolly, C. M., & Clonts, H. A. (1993). *Economics of aquaculture*. Food Products Press.
2. Kotler, P., & Keller, K. L. (2016). *Marketing management*. Pearson.
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
4. FAO. (2018). *Value chain analysis for fisheries and aquaculture*. FAO.
5. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.

Reference Books

1. Shepherd, A. W. (2007). *Approaches to linking producers to markets*. FAO.

2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
5. OECD. (2016). *Rebuilding fisheries and aquaculture*. OECD.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Fish Processing, Value Addition & Packaging

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fish spoilage and post-harvest losses
2. Study processing and preservation techniques
3. Analyze value addition methods
4. Examine packaging and quality standards
5. Improve product quality and market value

Course Outcomes

- CO1: Identify spoilage mechanisms and losses
- CO2: Apply processing and preservation techniques
- CO3: Develop value-added fish products
- CO4: Follow packaging and quality standards
- CO5: Enhance marketability of aquatic products

Detailed Syllabus

Unit I:
Post-harvest losses; fish spoilage mechanisms; biochemical changes; microbial activity; quality deterioration indicators; handling practices; hygiene principles; cold chain importance; shelf-life enhancement approaches.

Unit II:
Primary processing methods; cleaning, dressing, filleting; washing techniques; icing practices; chilling and freezing principles; equipment requirements; yield considerations; quality maintenance.

Unit III:
Value addition techniques; drying, salting, smoking; fermentation; marination; ready-to-cook products; traditional and modern methods; product diversification; consumer demand trends.

Unit IV:
Packaging materials; plastic, vacuum, modified atmosphere packaging; labeling requirements; storage conditions; transportation systems; quality standards; food safety regulations.

Unit V:
Processing economics; cost analysis; scale of operation; market potential; export requirements; certification standards; waste utilization; by-product recovery; sustainability aspects.

Text Books

1. Balachandran, K. K. (2014). *Post-harvest technology of fish*. Daya Publishing.
2. Huss, H. H. (1995). *Quality and quality changes in fresh fish*. FAO.
3. Connell, J. J. (1995). *Control of fish quality*. Fishing News Books.
4. FAO. (2018). *Fish handling and preservation*. FAO.
5. Stickney, R. R. (2009). *Aquaculture*. CABI.

Reference Books

1. FAO. (2022). *Seafood safety*. FAO.
2. Boyd, C. E. (2020). *Water quality*. Springer.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. ISO. (2018). *Food safety management systems*. ISO.
5. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Sustainable & Climate-Resilient Aquaculture

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand sustainability principles in aquaculture
2. Study climate change impacts on aquaculture systems

3. Analyze adaptation and mitigation strategies
4. Examine resource conservation approaches
5. Promote climate-resilient aquaculture practices

Course Outcomes

- CO1: Explain sustainability concepts in aquaculture
- CO2: Identify climate risks affecting aquaculture
- CO3: Apply climate adaptation strategies
- CO4: Promote resource-efficient farming practices
- CO5: Support resilient aquaculture development

Detailed Syllabus

Unit I:
Sustainable aquaculture concepts; ecological balance; carrying capacity; responsible farming principles; ecosystem-based approaches; environmental stewardship; long-term productivity considerations.

Unit II:
Climate change fundamentals; temperature rise; rainfall variability; extreme events; climate stressors on aquaculture species; vulnerability assessment; risk identification.

Unit III:
Adaptation strategies; species selection; system modification; water management; feed management; disease risk reduction; operational flexibility; adaptive management frameworks.

Unit IV:
Mitigation approaches; energy efficiency; renewable energy use; emission reduction; waste minimization; circular economy concepts; low-impact farming systems.

Unit V:
Policy and institutional frameworks; national and international initiatives; climate-resilient technologies; farmer capacity building; future prospects of sustainable aquaculture.

Text Books

1. FAO. (2018). *Climate change and aquaculture*. FAO.
2. Boyd, C. E. (2020). *Water quality*. Springer.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.
5. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.

Reference Books

1. FAO. (2022). *Sustainable aquaculture*. FAO.
2. OECD. (2018). *Climate resilience in agriculture*. OECD.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.
5. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I – Shrimp Farming

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles and scope of shrimp farming systems
2. Study biology and culture requirements of shrimp species
3. Analyze farm design and operational management practices
4. Examine health, biosecurity, and production economics
5. Promote sustainable and responsible shrimp farming

Course Outcomes

- CO1: Identify major shrimp species and their culture suitability
- CO2: Understand shrimp farm design and system requirements
- CO3: Apply scientific management practices in shrimp culture
- CO4: Analyze production performance and economic viability
- CO5: Promote sustainable and biosecure shrimp farming practices

Detailed Syllabus

Unit I:
Shrimp farming overview; global and Indian shrimp industry status; freshwater and marine shrimp species; Penaeus and Litopenaeus species; production systems classification; extensive, semi-intensive, intensive culture; export relevance; livelihood importance.

Unit II:
Shrimp biology and physiology; life cycle stages; molting process; growth patterns; feeding

behavior; environmental tolerance; salinity and temperature requirements; stress factors; implications for culture performance.

Unit III:
Shrimp farm design and management; site selection criteria; pond design parameters; soil and water requirements; pond preparation methods; stocking density norms; feeding management; water quality monitoring.

Unit IV:
Health management and biosecurity; common shrimp diseases; viral and bacterial infections; disease transmission pathways; preventive measures; biosecurity protocols; health surveillance; responsible chemical use; certification relevance.

Unit V:
Shrimp farming economics and sustainability; cost components; production budgeting; yield estimation; profitability indicators; market linkages; export standards; environmental impacts; waste management; sustainable shrimp farming frameworks.

Text Books

1. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices*. Blackwell.
2. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
3. New, M. B. (2010). *Aquaculture: A global perspective*. Wiley-Blackwell.
4. Stickney, R. R. (2009). *Aquaculture: An introductory text*. CABI.
5. FAO. (2017). *Shrimp farming and management*. FAO.

Reference Books

1. Lightner, D. V. (2011). *Virus diseases of farmed shrimp*. World Aquaculture Society.
2. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. Tacon, A. G. J. (2020). *Feed and feeding practices in aquaculture*. FAO.
5. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project (Farm Operations / Case Study)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply theoretical knowledge to real aquaculture problems
2. Analyze farm operations or case studies
3. Develop data collection and analytical skills
4. Prepare structured technical documentation
5. Enhance presentation and problem-solving skills

Course Outcomes

- CO1: Identify operational problems
- CO2: Collect and analyze farm-level data
- CO3: Apply appropriate analytical tools
- CO4: Prepare technical project reports
- CO5: Present findings effectively

Guidelines

Project identification; field data collection; analysis; report preparation; internal review; presentation and evaluation.

Evaluation Scheme

Continuous Assessment (60%) + Project Evaluation & Viva-Voce (40%)

SEMESTER VI

Regulatory Framework & Aquaculture Certification

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand national aquaculture regulatory frameworks
2. Examine international regulations governing aquatic products
3. Study certification standards and compliance mechanisms
4. Analyze legal responsibilities of aquaculture enterprises
5. Promote ethical and sustainable regulatory adherence

Course Outcomes

- CO1: Identify applicable aquaculture laws and regulations
- CO2: Interpret regulatory compliance requirements
- CO3: Understand aquaculture certification systems
- CO4: Prepare farms for audits and inspections
- CO5: Promote responsible and compliant aquaculture practices

Detailed Syllabus

Unit I:
Aquaculture regulatory framework in India; fisheries governance structure; Coastal Aquaculture Authority provisions; environmental protection laws; water and land use regulations; licensing procedures; statutory compliance requirements; enforcement mechanisms; policy objectives.

Unit II:
International regulatory environment; FAO codes and guidelines; WTO agreements; sanitary and phytosanitary measures; traceability requirements; import export regulations; global market access conditions; compliance challenges.

Unit III:
Aquaculture certification systems; organic aquaculture standards; eco-labeling concepts; best aquaculture practices standards; certification bodies; documentation requirements; audit processes; farm-level implementation strategies.

Unit IV:
Legal and ethical responsibilities; labor laws; occupational safety regulations; environmental

compliance; animal welfare considerations; record maintenance; penalties; dispute resolution mechanisms.

Unit V:
Emerging regulatory trends; sustainability reporting; climate compliance; digital traceability systems; policy reforms; industry preparedness; future regulatory directions.

Text Books

1. FAO. (2011). *Aquaculture certification guidelines*. FAO.
2. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
3. Boyd, C. E. (2020). *Water quality*. Springer.
4. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.
5. OECD. (2016). *Rebuilding fisheries and aquaculture*. OECD.

Reference Books

1. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. ISO. (2018). *Food safety and certification standards*. ISO.
5. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Export Management & International Trade of Aquatic Products

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand international trade principles for aquatic products
2. Study export procedures and documentation
3. Analyze quality and safety requirements for exports
4. Examine export marketing and logistics systems
5. Develop competence in global seafood trade management

Course Outcomes

- CO1: Explain fundamentals of international seafood trade
- CO2: Prepare export documentation
- CO3: Apply quality and safety standards for exports
- CO4: Manage logistics and trade risks
- CO5: Support export-oriented aquaculture enterprises

Detailed Syllabus

Unit I:
International trade fundamentals; export and import concepts; global seafood trade overview; major exporting nations; demand trends; trade policies; comparative advantage principles.

Unit II:
Export procedures; registration requirements; documentation; customs clearance; logistics management; cold chain requirements; packaging standards; shipping methods.

Unit III:
Quality and safety standards; HACCP principles; sanitary requirements; residue monitoring; certification for exports; importing country regulations; compliance audits.

Unit IV:
Pricing and contracts; INCOTERMS; payment mechanisms; letters of credit; foreign exchange management; export incentives; financial risk mitigation.

Unit V:
Trade challenges; tariff and non-tariff barriers; sustainability concerns; ethical trade practices; digital trade platforms; future prospects of aquatic product exports.

Text Books

1. Cherunilam, F. (2018). *International trade and export management*. Himalaya.
2. Kotler, P., & Keller, K. L. (2016). *Marketing management*. Pearson.
3. FAO. (2018). *Fishery and aquaculture trade*. FAO.
4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell.
5. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.

Reference Books

1. FAO. (2022). *Seafood trade and markets*. FAO.
2. OECD. (2019). *Rebuilding fisheries and aquaculture*. OECD.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. World Bank. (2017). *Logistics and trade facilitation*. World Bank.

5. Shepherd, A. W. (2007). *Linking producers to markets*. FAO.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Emerging Technologies in Aquaculture

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand emerging technological trends in aquaculture
2. Study automation and digital tools in farm management
3. Analyze advanced production systems
4. Examine data-driven decision-making technologies
5. Promote technology-enabled sustainable aquaculture

Course Outcomes

- CO1: Identify emerging aquaculture technologies
- CO2: Apply automation and digital monitoring tools
- CO3: Understand advanced culture systems
- CO4: Analyze technology-driven productivity improvements
- CO5: Support technology adoption in aquaculture

Detailed Syllabus

Unit I:
Technological evolution in aquaculture; automation concepts; digital transformation; sensors and monitoring tools; decision support systems; technology adoption drivers; productivity enhancement pathways.

Unit II:
Recirculating aquaculture systems; system components; water treatment units; biofiltration; system design principles; operational requirements; advantages and limitations.

Unit III:
Biofloc technology; microbial community management; carbon nitrogen ratio control; system setup; water quality stabilization; production benefits; operational challenges.

Unit IV:
Internet of Things applications; real-time monitoring; smart feeding systems; data analytics; artificial intelligence basics; predictive management tools.

Unit V:
Technology adoption challenges; cost considerations; skill requirements; scalability issues; sustainability impacts; future technological trends in aquaculture.

Text Books

1. Badiola, M., Mendiola, D., & Bostock, J. (2012). *Recirculating aquaculture systems*. FAO.
2. Boyd, C. E. (2020). *Water quality*. Springer.
3. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
4. FAO. (2019). *Innovation in aquaculture*. FAO.
5. New, M. B. (2010). *Aquaculture*. Wiley-Blackwell.

Reference Books

1. FAO. (2022). *Digital technologies in fisheries and aquaculture*. FAO.
2. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
3. Tacon, A. G. J. (2020). *Feed and feeding practices*. FAO.
4. OECD. (2018). *Innovation and sustainability*. OECD.
5. Lucas, J. S., & Southgate, P. C. (2012). *Aquaculture*. Wiley-Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II – Seaweed Culture

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand scope and importance of seaweed culture
2. Study biology and classification of commercially important seaweeds
3. Analyze seaweed farming systems and operational practices
4. Examine harvesting, processing, and economic aspects

5. Promote sustainable and eco-friendly seaweed aquaculture

Course Outcomes

- CO1: Identify major seaweed groups and species
- CO2: Understand seaweed culture systems and site requirements
- CO3: Apply operational management practices in seaweed farming
- CO4: Analyze economic and industrial utilization aspects
- CO5: Promote sustainable seaweed culture practices

Detailed Syllabus

Unit I:
Seaweed culture overview; importance of seaweeds; global and Indian seaweed resources; classification of seaweeds; green, brown, red algae; commercial significance; role in food, feed, fertilizer, pharmaceuticals; livelihood potential.

Unit II:
Seaweed biology and species selection; morphology and life cycles; important genera, Gracilaria, Kappaphycus, Sargassum, Ulva; growth requirements; environmental tolerance; site suitability criteria; seasonal availability considerations.

Unit III:
Seaweed farming systems; nearshore and offshore culture; raft, longline, net, and bottom culture methods; farm layout design; seed material preparation; planting techniques; maintenance operations; pest and grazing control.

Unit IV:
Harvesting and post-harvest management; harvesting intervals; drying methods; storage practices; processing basics; agar and carrageenan extraction overview; quality considerations; value addition opportunities.

Unit V:
Economics and sustainability of seaweed culture; cost components; small-scale enterprise models; yield estimation; market demand; export potential; environmental benefits; carbon sequestration role; integrated coastal livelihood development.

Text Books

1. Trono, G. C. (1997). *Manual on seaweed culture*. FAO.
2. McHugh, D. J. (2003). *A guide to the seaweed industry*. FAO.
3. Lobban, C. S., & Harrison, P. J. (1997). *Seaweed ecology and physiology*. Cambridge University Press.
4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices*. Blackwell.

5. FAO. (2018). *Seaweed aquaculture*. FAO.

Reference Books

1. Bixler, H. J., & Porse, H. (2011). *A decade of change in the seaweed hydrocolloids industry*. FAO.
2. De Silva, S. S. (2012). *Aquaculture systems*. Wiley-Blackwell.
3. Beveridge, M. C. M. (2004). *Cage aquaculture*. Blackwell.
4. FAO. (2022). *The state of world fisheries and aquaculture*. FAO.
5. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project (Industry / Farm Based)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Solve complex real-world aquaculture problems
2. Integrate multidisciplinary knowledge
3. Apply advanced analytical and technical skills
4. Develop professional documentation competence
5. Demonstrate industry readiness

Course Outcomes

- CO1: Define and analyze industry-level problems
- CO2: Design and implement practical solutions
- CO3: Interpret data and results effectively
- CO4: Prepare comprehensive project reports
- CO5: Defend project outcomes professionally

Guidelines

Industry or farm-based project selection; problem definition; methodology design; implementation; report submission; presentation and evaluation.

Evaluation Scheme

Continuous Assessment (60%) + Project Evaluation & Viva-Voce (40%)

Seminar / Viva-Voce

Course Category: Seminar / Viva-Voce Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop technical communication skills
2. Review contemporary aquaculture topics
3. Enhance analytical and presentation abilities
4. Prepare for professional evaluation
5. Demonstrate comprehensive programme learning

Course Outcomes

- CO1: Present technical topics effectively
- CO2: Analyze contemporary aquaculture issues
- CO3: Respond to technical queries confidently
- CO4: Demonstrate integrative understanding
- CO5: Exhibit professional presentation skills

Guidelines

Topic selection; literature review; seminar presentation; viva-voce examination; evaluation by internal and external experts.

Evaluation Scheme

Seminar Presentation (50%) + Viva-Voce Examination (50%)

B.A. – Psychology, Cognitive Science & Mental Health

Duration: 3 Years | 6 SEMESTER s | Total Credits: 120

SEMESTER I

Introduction to Psychology

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To establish foundational understanding of psychology as a scientific discipline
2. To familiarize core psychological concepts, schools, and perspectives
3. To examine biological, cognitive, and socio-cultural bases of behaviour
4. To develop analytical thinking related to human behaviour
5. To prepare learners for advanced psychological studies

Course Outcomes

- CO1: Understand scope, methods, and applications of psychology
- CO2: Identify major psychological perspectives and contributors
- CO3: Explain biological and cognitive foundations of behaviour
- CO4: Analyze individual differences and motivation
- CO5: Apply psychological concepts to real-life contexts

Detailed Syllabus

Unit I
Nature and scope of psychology; scientific methods, objectives, historical evolution; schools of thought, structuralism, functionalism, behaviourism, gestalt, psychoanalysis, humanistic approach; psychology as science and profession; interdisciplinary relevance, contemporary perspectives.

Unit II
Biological bases of behaviour; structure and functions of nervous system; neurons, synaptic transmission, neurotransmitters; endocrine system, hormones, behaviour regulation; brain structures, hemispheric specialization; genetic influences, heredity, environment interaction.

Unit III
Sensory processes and perception; thresholds, psychophysics; vision, hearing, other senses;

perceptual organization principles; attention mechanisms; consciousness, altered states; sleep, dreams, circadian rhythms; applications in everyday functioning.

Unit IV
Learning processes; classical conditioning, operant conditioning, observational learning; reinforcement schedules; cognitive learning theories; memory systems, encoding, storage, retrieval; forgetting theories; improving memory strategies; educational and behavioural implications.

Unit V
Motivation and emotion; biological and psychological motives; theories of motivation; emotion components, theories; stress, coping mechanisms; personality concepts, major theories; assessment overview; individual differences; mental health relevance.

Text Books

1. Ciccarelli, S. K., & White, J. N. (2021). *Psychology* (6th ed.). Pearson Education.
2. Feldman, R. S. (2020). *Understanding psychology* (14th ed.). McGraw-Hill Education.
3. Baron, R. A., & Misra, G. (2018). *Psychology* (5th ed.). Pearson India.
4. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (2019). *Introduction to psychology* (8th ed.). McGraw-Hill.
5. Passer, M. W., & Smith, R. E. (2019). *Psychology: The science of mind and behaviour* (7th ed.). McGraw-Hill.

Reference Books

1. Carlson, N. R., & Birkett, M. A. (2021). *Physiology of behavior* (14th ed.). Pearson.
2. Goldstein, E. B. (2020). *Sensation and perception* (10th ed.). Cengage Learning.
3. Atkinson, R. L., Atkinson, R. C., Smith, E. E., & Bem, D. J. (2018). *Introduction to psychology*. Harcourt Brace.
4. Zimbardo, P. G., Johnson, R. L., & McCann, V. (2020). *Psychology: Core concepts* (8th ed.). Pearson.
5. Wade, C., & Tavris, C. (2017). *Psychology* (12th ed.). Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Foundations of Cognitive Science

Course Category: Engineering Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To introduce interdisciplinary foundations of cognitive science
2. To examine cognition through psychology, neuroscience, linguistics, AI
3. To understand models of mind and information processing
4. To relate cognition to perception, language, and decision making
5. To prepare learners for applied cognitive science studies

Course Outcomes

- CO1: Explain scope and history of cognitive science
- CO2: Describe cognitive processes and mental representations
- CO3: Relate brain mechanisms to cognition
- CO4: Analyze language, reasoning, and problem solving
- CO5: Apply cognitive models to real-world contexts

Detailed Syllabus

Unit I
Introduction to cognitive science; historical origins; interdisciplinary nature; psychology, neuroscience, linguistics, artificial intelligence, philosophy; levels of analysis; cognitive revolution; information processing approach; mind as computational system.

Unit II
Perception and attention; bottom-up and top-down processing; visual and auditory perception models; attentional mechanisms; selective, divided attention; cognitive load; perceptual constancies; experimental approaches in cognition research.

Unit III
Memory systems; sensory, short-term, working memory; long-term memory types; encoding and retrieval models; schemas, mental representations; forgetting mechanisms; cognitive architectures; neural correlates of memory.

Unit IV
Language and cognition; structure of language; phonology, syntax, semantics, pragmatics; language acquisition theories; psycholinguistics; thought and language relationship; bilingualism; cognitive and neural perspectives.

Unit V
Reasoning, problem solving, decision making; heuristics and biases; cognitive models of

reasoning; creativity; intelligence concepts; artificial intelligence foundations; human-computer interaction; cognitive science applications.

Text Books

1. Friedenberg, J., & Silverman, G. (2015). *Cognitive science: An introduction to the study of mind* (3rd ed.). Sage.
2. Eysenck, M. W., & Keane, M. T. (2020). *Cognitive psychology: A student's handbook* (8th ed.). Psychology Press.
3. Thagard, P. (2018). *Mind: Introduction to cognitive science* (2nd ed.). MIT Press.
4. Goldstein, E. B. (2019). *Cognitive psychology: Connecting mind, research, and everyday experience* (5th ed.). Cengage.
5. Sternberg, R. J., & Sternberg, K. (2017). *Cognitive psychology* (7th ed.). Cengage.

Reference Books

1. Anderson, J. R. (2015). *Cognitive psychology and its implications* (8th ed.). Worth.
2. Reisberg, D. (2014). *Cognition: Exploring the science of the mind* (6th ed.). Norton.
3. Baddeley, A., Eysenck, M. W., & Anderson, M. C. (2020). *Memory* (3rd ed.). Psychology Press.
4. Pinker, S. (2018). *The language instinct*. Penguin.
5. Sloman, S., & Fernbach, P. (2017). *The knowledge illusion*. Riverhead Books.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Biological Basis of Behaviour

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand biological foundations of human behaviour
2. To examine nervous system structure and functioning
3. To analyze brain mechanisms underlying cognition and emotion
4. To relate genetics and hormones with behaviour
5. To build biological perspectives for psychological studies

Course Outcomes

- CO1: Describe organization of nervous system
- CO2: Explain neuronal communication mechanisms
- CO3: Identify brain structures and behavioural functions
- CO4: Relate endocrine and genetic influences to behaviour
- CO5: Apply biological concepts to psychological phenomena

Detailed Syllabus

Unit I
Introduction to biopsychology; historical development; mind–brain relationship; levels of biological analysis; methods in behavioural neuroscience; ethics in biological research; interdisciplinary relevance; applications in psychology and mental health practice.

Unit II
Neuron structure and function; action potential; synaptic transmission; neurotransmitters; excitatory and inhibitory processes; neural plasticity; organization of neural networks; principles of neural communication in behaviour regulation.

Unit III
Central nervous system; brain development; cerebral cortex organization; lobes and functional areas; subcortical structures; limbic system; hemispheric specialization; lateralization of functions; neuroimaging techniques overview.

Unit IV
Peripheral nervous system; autonomic nervous system; sympathetic and parasympathetic divisions; endocrine system; major glands; hormones and behaviour; stress response mechanisms; homeostasis; interaction between nervous and endocrine systems.

Unit V
Genetics and behaviour; heredity principles; genes and chromosomes; behavioural genetics methods; twin and adoption studies; gene–environment interaction; evolutionary perspectives; biological basis of motivation, emotion, and psychopathology.

Text Books

1. Carlson, N. R., & Birkett, M. A. (2021). *Physiology of behavior* (14th ed.). Pearson.
2. Pinel, J. P. J., & Barnes, S. (2021). *Biopsychology* (11th ed.). Pearson.
3. Breedlove, S. M., Watson, N. V., & Rosenzweig, M. R. (2019). *Biological psychology* (7th ed.). Sinauer.
4. Kolb, B., & Whishaw, I. Q. (2020). *Fundamentals of human neuropsychology* (8th ed.). Worth.
5. Bear, M. F., Connors, B. W., & Paradiso, M. A. (2020). *Neuroscience: Exploring the brain* (4th ed.). Wolters Kluwer.

Reference Books

1. Kandel, E. R., Koester, J. D., Mack, S. H., & Siegelbaum, S. A. (2021). *Principles of neural science* (6th ed.). McGraw-Hill.
2. Kalat, J. W. (2019). *Biological psychology* (13th ed.). Cengage.
3. Carlson, N. R. (2018). *Foundations of physiological psychology*. Pearson.
4. Purves, D., et al. (2018). *Neuroscience* (6th ed.). Oxford University Press.
5. Rosenzweig, M. R., Breedlove, S. M., & Leiman, A. L. (2016). *Biological psychology*. Sinauer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Basics of Sociology & Human Behaviour

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce sociological perspectives of human behaviour
2. To understand social structures and institutions
3. To analyze culture, norms, and socialization processes
4. To examine social stratification and inequality
5. To relate sociology with psychological understanding

Course Outcomes

- CO1: Explain basic sociological concepts
- CO2: Identify social institutions and functions
- CO3: Analyze culture and socialization
- CO4: Understand social inequality mechanisms
- CO5: Apply sociological perspectives to behaviour

Detailed Syllabus

Unit I
Sociology as a discipline; scope and relevance; society and social interaction; sociological imagination; relationship between sociology and psychology; basic concepts, status, role, norms, values; social groups and institutions.

Unit II
Culture and society; elements of culture; material and nonmaterial culture; cultural diversity; socialization processes; agents of socialization; family, education, media; cultural transmission and behavioural patterns.

Unit III
Social structure; institutions, family, education, religion, economy, polity; functions and dysfunctions; social control mechanisms; conformity and deviance; law, customs, and moral order.

Unit IV
Social stratification; caste, class, gender; social inequality; mobility; poverty and exclusion; power and authority; social change; modernization; globalization and its impact on human behaviour.

Unit V
Social issues and behaviour; population, urbanization, migration; social problems; health and illness; community and social well-being; relevance of sociology for mental health and social development.

Text Books

1. Giddens, A. (2017). *Sociology* (7th ed.). Polity Press.
2. Haralambos, M., & Holborn, M. (2013). *Sociology: Themes and perspectives* (8th ed.). Collins.
3. Johnson, H. M. (2015). *Sociology: A systematic introduction*. Allied Publishers.
4. Inkeles, A. (2016). *What is sociology?* Prentice Hall.
5. Rao, C. N. S. (2018). *Sociology: Principles of sociology with an introduction to social thought*. S. Chand.

Reference Books

1. Horton, P. B., & Hunt, C. L. (2014). *Sociology*. McGraw-Hill.
2. Bottomore, T. B. (2017). *Sociology: A guide to problems and literature*. Routledge.
3. Macionis, J. J. (2018). *Sociology* (16th ed.). Pearson.
4. Singh, Y. (2016). *Modernization of Indian tradition*. Rawat.
5. Patel, S. (2019). *Social structure and change*. Oxford University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Academic Writing & Communication Skills

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop academic writing competence
2. To enhance reading and critical analysis skills
3. To improve oral and written communication
4. To train referencing and plagiarism ethics
5. To prepare students for academic presentations

Course Outcomes

- CO1: Write structured academic texts
- CO2: Apply critical reading strategies
- CO3: Communicate ideas effectively
- CO4: Use academic referencing styles
- CO5: Demonstrate presentation skills

Detailed Syllabus

Unit I
Academic writing fundamentals; characteristics of academic texts; formal tone; coherence and cohesion; paragraph structure; thesis statements; argument development; clarity and precision in scholarly writing.

Unit II
Reading strategies; critical reading; summarizing and paraphrasing; note-taking techniques; identifying arguments; evaluating sources; academic vocabulary development; comprehension enhancement.

Unit III
Writing process; prewriting, drafting, revising, editing; essay types; analytical and argumentative writing; logical organization; transitions; coherence maintenance; academic style conventions.

Unit IV
Referencing and citation; APA style basics; in-text citations; reference lists; plagiarism concepts; academic integrity; ethical writing practices; use of digital reference tools.

Unit V
Oral communication; academic presentations; seminar skills; group discussions; listening skills; nonverbal communication; visual aids; professional communication contexts.

Text Books

1. Bailey, S. (2018). *Academic writing: A handbook for international students* (4th ed.). Routledge.
2. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students*. University of Michigan Press.
3. Hedge, T. (2015). *Writing*. Oxford University Press.
4. Murray, R. (2017). *How to write a thesis* (4th ed.). Open University Press.
5. Jordan, R. R. (2014). *Academic writing course*. Pearson.

Reference Books

1. APA. (2020). *Publication manual of the American Psychological Association* (7th ed.). APA.
2. Cottrell, S. (2019). *The study skills handbook*. Palgrave.
3. Hartley, J. (2018). *Academic writing and publishing*. Routledge.
4. Williams, J. M. (2014). *Style: Lessons in clarity and grace*. Pearson.
5. Alley, M. (2013). *The craft of scientific presentations*. Springer.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Digital Literacy for Social Sciences

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To develop essential digital competencies
2. To use digital tools for academic purposes
3. To understand data, media, and information literacy
4. To promote ethical and safe digital practices
5. To apply digital skills in social sciences

Course Outcomes

- CO1: Use digital tools for learning
- CO2: Evaluate online information critically

- CO3: Apply basic data handling skills
- CO4: Practice digital ethics and security
- CO5: Integrate technology in academic work

Detailed Syllabus

Unit I
Digital literacy concepts; digital society; ICT fundamentals; hardware and software basics; operating systems; digital ecosystems; relevance for social sciences education and research.

Unit II
Internet and information literacy; search strategies; academic databases; evaluating online sources; misinformation; digital footprints; online collaboration tools; scholarly communication platforms.

Unit III
Productivity tools; word processing; spreadsheets; presentations; data visualization basics; documentation standards; collaborative writing tools; academic applications.

Unit IV
Data literacy; basic data types; data collection; simple analysis; interpretation; ethical data use; privacy concerns; data protection principles.

Unit V
Digital ethics and safety; cyber security basics; intellectual property; open access; responsible digital citizenship; technology and society interface.

Text Books

1. Gilster, P. (2017). *Digital literacy*. Wiley.
2. Buckingham, D. (2015). *Defining digital literacy*. Nordic Journal of Digital Literacy.
3. Belshaw, D. (2014). *The essential elements of digital literacies*. Mozilla.
4. UNESCO. (2018). *Digital literacy global framework*. UNESCO.
5. Hargittai, E. (2019). *Digital literacy and skills*. Oxford University Press.

Reference Books

1. Rheingold, H. (2012). *Net smart*. MIT Press.
2. Floridi, L. (2014). *The fourth revolution*. Oxford University Press.
3. Castells, M. (2015). *The rise of the network society*. Wiley.
4. Mossberger, K. (2018). *Digital citizenship*. MIT Press.
5. Van Dijk, J. (2020). *The digital divide*. Polity.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Field Orientation / Observational Study

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To expose students to real-world social settings
2. To develop observation and documentation skills
3. To understand ethical field practices
4. To relate theory with practice
5. To build professional orientation

Course Outcomes

- CO1: Conduct systematic field observations
- CO2: Record and analyze behavioural data
- CO3: Demonstrate ethical field conduct
- CO4: Relate observations to theory
- CO5: Prepare structured field reports

Guidelines

Identification of field setting; orientation sessions; observation framework; ethical clearance; supervision; documentation format; reflective analysis; submission protocol.

Evaluation Scheme

Field Work Report (60%) + Viva-Voce (40%)

SEMESTER II

Developmental Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand principles of human development across lifespan
2. To examine physical, cognitive, and socio-emotional development
3. To analyze developmental theories and perspectives
4. To study individual differences in development
5. To relate development to mental health contexts

Course Outcomes

- CO1: Explain lifespan developmental concepts
- CO2: Describe major developmental theories
- CO3: Analyze cognitive and emotional development
- CO4: Understand social and moral development
- CO5: Apply developmental knowledge to real contexts

Detailed Syllabus

Unit I
Developmental psychology scope; life span approach; growth, maturation, learning; research methods; genetic and environmental influences; prenatal development stages; birth processes; developmental hazards; ethical considerations.

Unit II
Infancy and early childhood; physical growth patterns; motor development; sensory capacities; cognitive development stages; language acquisition; attachment theories; emotional regulation; early social relationships.

Unit III
Middle childhood development; physical changes; cognitive abilities; intelligence theories; moral development; peer relations; schooling influences; self-concept formation; behavioural adjustment patterns.

Unit IV
Adolescence development; puberty changes; identity formation; cognitive transitions; emotional instability; peer influence; risk behaviours; psychosocial challenges; mental health implications.

Unit V
Adulthood and aging; early, middle, late adulthood; career development; relationships; cognitive aging; personality stability; successful aging; developmental psychopathology perspectives.

Text Books

1. Santrock, J. W. (2020). *Life-span development* (17th ed.). McGraw-Hill.
2. Berk, L. E. (2018). *Development through the lifespan* (7th ed.). Pearson.
3. Papalia, D. E., Olds, S. W., & Feldman, R. D. (2019). *Human development* (13th ed.). McGraw-Hill.
4. Sigelman, C. K., & Rider, E. A. (2020). *Life-span human development* (9th ed.). Cengage.
5. Shaffer, D. R., & Kipp, K. (2018). *Developmental psychology* (10th ed.). Cengage.

Reference Books

1. Hurlock, E. B. (2017). *Developmental psychology*. McGraw-Hill.
2. Lerner, R. M. (2018). *Handbook of child psychology*. Wiley.
3. Vasta, R., Haith, M. M., & Miller, S. A. (2016). *Child psychology*. Wiley.
4. Baltes, P. B. (2019). *Life-span development*. Academic Press.
5. Eisenberg, N. (2020). *Social, emotional development*. Guilford.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Learning, Memory & Cognition

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand learning and memory processes
2. To study cognitive theories and models
3. To examine attention and information processing
4. To relate cognition with behaviour
5. To apply cognitive principles practically

Course Outcomes

- CO1: Explain learning theories
- CO2: Describe memory systems
- CO3: Analyze cognitive processing
- CO4: Understand attention mechanisms
- CO5: Apply cognition concepts

Detailed Syllabus

Unit I
Learning concepts; classical conditioning; operant conditioning; reinforcement schedules; observational learning; cognitive learning theories; behaviour modification; educational and clinical applications.

Unit II
Memory systems; sensory memory; short-term memory; working memory models; long-term memory; encoding processes; storage mechanisms; retrieval cues; forgetting explanations.

Unit III
Cognition foundations; information processing models; mental representations; schemas; imagery; concept formation; cognitive development perspectives; limitations of processing capacity.

Unit IV
Attention mechanisms; selective attention; divided attention; sustained attention; cognitive control; executive functions; multitasking effects; attentional disorders overview.

Unit V
Problem solving; reasoning types; decision making; heuristics; biases; creativity; intelligence theories; cognitive enhancement strategies.

Text Books

1. Goldstein, E. B. (2019). *Cognitive psychology* (5th ed.). Cengage.
2. Eysenck, M. W., & Keane, M. T. (2020). *Cognitive psychology* (8th ed.). Psychology Press.
3. Baddeley, A. (2015). *Memory*. Psychology Press.
4. Anderson, J. R. (2015). *Cognitive psychology*. Worth.
5. Sternberg, R. J. (2017). *Cognitive psychology*. Cengage.

Reference Books

1. Reisberg, D. (2014). *Cognition*. Norton.
2. Solso, R. L. (2017). *Cognitive psychology*. Pearson.

3. Matlin, M. W. (2019). *Cognition*. Wiley.
4. Neisser, U. (2018). *Cognitive psychology*. Psychology Press.
5. Kellogg, R. T. (2016). *Cognitive psychology*. Sage.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Statistics for Behavioural Sciences

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce statistical concepts
2. To apply statistics in behavioural research
3. To understand data analysis techniques
4. To interpret research findings
5. To develop quantitative reasoning

Course Outcomes

- CO1: Understand descriptive statistics
- CO2: Apply inferential statistics
- CO3: Analyze behavioural data
- CO4: Interpret statistical results
- CO5: Use statistics in research

Detailed Syllabus

Unit I
Statistics fundamentals; data types; scales of measurement; frequency distributions; graphical representations; measures of central tendency; measures of variability; data summarization.

Unit II
Probability concepts; normal distribution; sampling methods; sampling error; hypothesis testing logic; null hypothesis; significance levels; confidence intervals.

Unit III
Inferential statistics; t-tests; z-tests; assumptions; effect size; nonparametric tests overview; applications in psychology research.

Unit IV
Correlation analysis; Pearson correlation; Spearman correlation; regression basics; prediction; interpretation of coefficients; limitations.

Unit V
Introduction to ANOVA; one-way ANOVA; assumptions; post-hoc tests; statistical reporting; ethical use of statistics.

Text Books

1. Gravetter, F. J., & Wallnau, L. B. (2020). *Statistics for the behavioral sciences* (10th ed.). Cengage.
2. Aron, A., Aron, E. N., & Coups, E. J. (2019). *Statistics for psychology*. Pearson.
3. Coolican, H. (2017). *Research methods and statistics in psychology*. Psychology Press.
4. Howell, D. C. (2018). *Statistical methods for psychology*. Cengage.
5. Field, A. (2018). *Discovering statistics using SPSS*. Sage.

Reference Books

1. Guilford, J. P. (2015). *Fundamental statistics in psychology*. McGraw-Hill.
2. Siegel, S. (2016). *Nonparametric statistics*. McGraw-Hill.
3. Kerlinger, F. N. (2017). *Foundations of behavioral research*. Holt.
4. Runyon, R. P. (2018). *Fundamentals of behavioral statistics*. McGraw-Hill.
5. Levin, J. (2019). *Statistics for psychology*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Philosophy of Mind & Consciousness

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce philosophical foundations of mind studies
2. To examine theories of consciousness
3. To analyze mind–body relationship
4. To understand philosophical perspectives on cognition

5. To relate philosophy of mind to psychology and cognitive science

Course Outcomes

- CO1: Explain key philosophical concepts of mind
- CO2: Compare major mind–body theories
- CO3: Analyze consciousness perspectives
- CO4: Relate philosophy with cognitive science
- CO5: Apply philosophical reasoning to mental phenomena

Detailed Syllabus

Unit I
Philosophy of mind scope; historical background; nature of mind; mental phenomena; philosophical inquiry methods; relation to psychology and neuroscience; conceptual analysis; interdisciplinary relevance.

Unit II
Mind–body problem; dualism; interactionism; materialism; identity theory; functionalism; physicalism; philosophical arguments; critiques and limitations.

Unit III
Consciousness concepts; subjective experience; qualia; levels of consciousness; awareness; self-consciousness; altered states; philosophical interpretations; cognitive relevance.

Unit IV
Mental representation; intentionality; perception and reality; representation theories; computational mind; language and thought; artificial intelligence perspectives.

Unit V
Free will and agency; determinism; moral responsibility; personal identity; self and continuity; implications for psychology; mental health and ethics.

Text Books

1. Heil, J. (2018). *Philosophy of mind* (3rd ed.). Routledge.
2. Kim, J. (2011). *Philosophy of mind* (3rd ed.). Westview Press.
3. Chalmers, D. J. (2010). *The conscious mind*. Oxford University Press.
4. Churchland, P. S. (2013). *Matter and consciousness*. MIT Press.
5. Braddon-Mitchell, D., & Jackson, F. (2007). *Philosophy of mind and cognition*. Blackwell.

Reference Books

1. Dennett, D. C. (2017). *From bacteria to Bach and back*. Norton.

2. Searle, J. R. (1992). *The rediscovery of the mind*. MIT Press.
3. Nagel, T. (1979). *Mortal questions*. Cambridge University Press.
4. Crane, T. (2018). *The mechanical mind*. Routledge.
5. Revonsuo, A. (2010). *Consciousness*. Psychology Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Social Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand social behaviour and interaction
2. To examine individual behaviour in social contexts
3. To analyze attitudes and social influence
4. To study group dynamics and relationships
5. To apply social psychology principles

Course Outcomes

- CO1: Explain social psychological concepts
- CO2: Analyze attitude formation and change
- CO3: Understand social influence processes
- CO4: Examine group behaviour
- CO5: Apply social psychology to society

Detailed Syllabus

Unit I
Social psychology nature; scope; methods; social perception; attribution theories; impression formation; self-concept; self-esteem; social cognition foundations.

Unit II
Attitudes; components; formation; measurement; attitude change; persuasion theories; communication; resistance to persuasion; media influence.

Unit III
Social influence; conformity; compliance; obedience; leadership; power; authority; social norms; cultural influences on behaviour.

Unit IV
Group processes; group structure; roles; norms; cohesion; decision making; groupthink; intergroup relations; prejudice; discrimination.

Unit V
Prosocial behaviour; aggression; altruism; helping behaviour; interpersonal attraction; relationships; applications in health, education, organizations.

Text Books

1. Baron, R. A., Byrne, D., & Branscombe, N. R. (2018). *Social psychology* (14th ed.). Pearson.
2. Myers, D. G., & Twenge, J. M. (2021). *Social psychology* (14th ed.). McGraw-Hill.
3. Aronson, E., Wilson, T. D., & Sommers, S. R. (2019). *Social psychology* (10th ed.). Pearson.
4. Hogg, M. A., & Vaughan, G. M. (2018). *Social psychology* (8th ed.). Pearson.
5. Taylor, S. E., Peplau, L. A., & Sears, D. O. (2015). *Social psychology* (14th ed.). Pearson.

Reference Books

1. Forsyth, D. R. (2018). *Group dynamics*. Cengage.
2. Brown, R. (2010). *Prejudice*. Wiley.
3. Baumeister, R. F., & Bushman, B. J. (2017). *Social psychology and human nature*. Cengage.
4. Hewstone, M. (2016). *An introduction to social psychology*. Wiley.
5. Allport, G. W. (2013). *The nature of prejudice*. Basic Books.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Human-Centred Approaches

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To introduce design thinking principles

2. To develop human-centred problem-solving skills
3. To apply creativity and innovation methods
4. To integrate empathy in solution development
5. To relate design thinking with social sciences

Course Outcomes

- CO1: Understand design thinking concepts
- CO2: Apply human-centred design methods
- CO3: Develop innovative solutions
- CO4: Use empathy-driven approaches
- CO5: Integrate design thinking in social contexts

Detailed Syllabus

Unit I
Design thinking overview; origins; principles; human-centred philosophy; innovation mindset; relevance to social sciences; interdisciplinary applications.

Unit II
Empathy stage; user research methods; observation; interviews; personas; user journeys; problem identification; needs analysis.

Unit III
Define and ideation stages; problem framing; brainstorming techniques; creativity tools; idea evaluation; concept development.

Unit IV
Prototyping; low-fidelity and high-fidelity prototypes; testing methods; feedback incorporation; iterative design; evaluation metrics.

Unit V
Design thinking applications; social innovation; service design; policy design; ethical considerations; sustainability; impact assessment.

Text Books

1. Brown, T. (2009). *Change by design*. HarperCollins.
2. Liedtka, J., & Ogilvie, T. (2011). *Designing for growth*. Columbia University Press.
3. Plattner, H., Meinel, C., & Leifer, L. (2011). *Design thinking*. Springer.
4. Stickdorn, M., & Schneider, J. (2012). *This is service design thinking*. BIS.
5. IDEO. (2015). *The field guide to human-centered design*. IDEO.

Reference Books

1. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown.
2. Norman, D. A. (2013). *The design of everyday things*. Basic Books.
3. Martin, R. L. (2009). *The design of business*. Harvard Business Press.
4. Cross, N. (2011). *Design thinking*. Berg.
5. Buchanan, R. (2019). *Systems thinking and design*. MIT Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship / Community Exposure

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To provide community-based experiential learning
2. To expose students to social and mental health settings
3. To develop observation and interaction skills
4. To apply classroom knowledge in real contexts
5. To build ethical and professional conduct

Course Outcomes

- CO1: Engage with community organizations
- CO2: Observe social and behavioural issues
- CO3: Demonstrate ethical practices
- CO4: Relate theory to practice
- CO5: Document community exposure learning

Guidelines

Identification of community organization; orientation programme; supervised engagement; observation framework; ethical compliance; reflective documentation; report submission; viva-voce assessment.

Evaluation Scheme

Community Exposure Report (60%) + Viva-Voce (40%)

SEMESTER III

Abnormal Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand concepts of normality and abnormality
2. To study classification of psychological disorders
3. To examine causes and models of psychopathology
4. To understand symptoms and diagnostic features
5. To relate abnormal psychology to mental health practice

Course Outcomes

- CO1: Explain concepts and criteria of abnormal behaviour
- CO2: Classify major psychological disorders
- CO3: Analyze etiological models of psychopathology
- CO4: Identify clinical features of mental disorders
- CO5: Apply abnormal psychology concepts in mental health contexts

Detailed Syllabus

Unit I
Abnormal psychology scope; concepts of normality, abnormality; historical perspectives; cultural considerations; models of abnormal behaviour, biological, psychological, socio-cultural; classification systems overview; mental health relevance.

Unit II
Anxiety disorders; phobias; panic disorder; generalized anxiety disorder; obsessive compulsive disorder; trauma related disorders; symptoms; risk factors; epidemiology; behavioural and cognitive perspectives.

Unit III
Mood disorders; depressive disorders; bipolar disorders; clinical features; biological and psychological explanations; stress vulnerability model; assessment overview; social and functional impact.

Unit IV
Psychotic disorders; schizophrenia spectrum; positive and negative symptoms; course and outcome; neurobiological correlates; socio-cultural factors; stigma and rehabilitation perspectives.

Unit V

Personality disorders; classification; clusters; clinical characteristics; developmental perspectives; comorbidity; overview of childhood and neurodevelopmental disorders; mental health implications.

Text Books

1. Butcher, J. N., Hooley, J. M., & Mineka, S. (2021). *Abnormal psychology* (18th ed.). Pearson.
2. Barlow, D. H., & Durand, V. M. (2020). *Abnormal psychology* (9th ed.). Cengage.
3. American Psychiatric Association. (2022). *DSM-5-TR*. APA.
4. Kring, A. M., Johnson, S. L., Davison, G. C., & Neale, J. M. (2018). *Abnormal psychology* (13th ed.). Wiley.
5. Comer, R. J. (2021). *Abnormal psychology* (11th ed.). Worth.

Reference Books

1. Sadock, B. J., Sadock, V. A., & Ruiz, P. (2017). *Kaplan & Sadock's synopsis of psychiatry*. Wolters Kluwer.
2. Carson, R. C., Butcher, J. N., & Mineka, S. (2016). *Abnormal psychology and modern life*. Pearson.
3. Kearney, C. A. (2015). *Casebook in child and adolescent psychopathology*. Sage.
4. Gelder, M. (2012). *Oxford textbook of psychiatry*. Oxford.
5. Sue, D., Sue, D. W., & Sue, S. (2016). *Understanding abnormal behavior*. Cengage.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Cognitive Neuroscience

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand neural basis of cognition
2. To examine brain mechanisms underlying mental processes
3. To study cognitive functions and neural systems
4. To understand neuroimaging methods
5. To relate neuroscience with cognitive science

Course Outcomes

- CO1: Explain brain organization and cognitive functions
- CO2: Describe neural mechanisms of perception and memory
- CO3: Analyze language and attention systems
- CO4: Understand neuroimaging techniques
- CO5: Apply cognitive neuroscience concepts

Detailed Syllabus

Unit I
Cognitive neuroscience scope; historical development; brain organization; neurons and networks; methods in cognitive neuroscience; ethics; interdisciplinary integration with psychology and cognitive science.

Unit II
Perception and action; visual pathways; auditory processing; somatosensory systems; motor control; mirror neurons; neural coding; perception–action coupling.

Unit III
Attention and consciousness; attentional networks; executive control; neural correlates of awareness; altered states; disorders of attention; brain mechanisms.

Unit IV
Memory systems; hippocampus; working memory networks; long-term memory; neural plasticity; learning mechanisms; neurobiological models.

Unit V
Language and higher cognition; language areas; aphasia; decision making; emotion and cognition interaction; social neuroscience overview.

Text Books

1. Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2019). *Cognitive neuroscience* (5th ed.). Norton.
2. Ward, J. (2020). *The student's guide to cognitive neuroscience* (4th ed.). Psychology Press.
3. Banich, M. T., & Compton, R. J. (2018). *Cognitive neuroscience* (4th ed.). Cambridge University Press.
4. Bear, M. F., Connors, B. W., & Paradiso, M. A. (2020). *Neuroscience*. Wolters Kluwer.
5. Carlson, N. R., & Birkett, M. A. (2021). *Physiology of behavior*. Pearson.

Reference Books

1. Kandel, E. R. et al. (2021). *Principles of neural science*. McGraw-Hill.
2. Purves, D. et al. (2018). *Neuroscience*. Oxford.
3. Posner, M. I. (2014). *Cognitive neuroscience of attention*. Guilford.
4. Rolls, E. T. (2014). *Emotion and decision-making*. Oxford.
5. Damasio, A. (2018). *The strange order of things*. Pantheon.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Psychological Assessment & Testing

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand principles of psychological testing
2. To study test construction and standardization
3. To examine intelligence and personality assessment
4. To understand ethical testing practices
5. To develop basic assessment skills

Course Outcomes

- CO1: Explain assessment concepts
- CO2: Understand psychometric properties
- CO3: Identify major psychological tests
- CO4: Apply ethical assessment principles
- CO5: Interpret basic test results

Detailed Syllabus

Unit I
Psychological assessment concepts; measurement scales; reliability; validity; norms; standardization; test administration; interpretation principles.

Unit II
Intelligence assessment; intelligence theories; individual and group tests; cultural considerations; applications; limitations.

Unit III
Personality assessment; objective and projective techniques; inventories; clinical applications; behavioural assessment overview.

Unit IV
Assessment of aptitude, interest, attitude; educational and vocational testing; use in guidance and counselling.

Unit V
Ethical issues; test misuse; cultural bias; professional guidelines; assessment in mental health settings.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Research Methods in Psychology

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand scientific research foundations in psychology
2. To familiarize research designs and methodologies
3. To develop data collection and analysis awareness
4. To understand ethical issues in psychological research
5. To prepare students for independent research work

Course Outcomes

- CO1: Explain psychological research processes
- CO2: Identify appropriate research designs
- CO3: Apply data collection methods
- CO4: Understand ethical research practices
- CO5: Interpret basic research findings

Detailed Syllabus

Unit I
Nature of psychological research; scientific inquiry; research objectives; variables; hypotheses formulation; operational definitions; theory building; research problems identification; scope and limitations of behavioural research.

Unit II
Research designs; experimental, quasi-experimental, correlational; independent and dependent variables; control techniques; internal and external validity; laboratory and field research.

Unit III
Sampling methods; probability and non-probability sampling; sample size determination; data collection tools; observation; interviews; questionnaires; surveys; scaling techniques.

Unit IV
Qualitative research methods; case study; phenomenology; content analysis; focus groups; narrative approaches; mixed methods; strengths and limitations.

Unit V
Ethical considerations; informed consent; confidentiality; deception; risk management; research ethics committees; reporting standards; plagiarism; responsible conduct of research.

Text Books

1. Kerlinger, F. N., & Lee, H. B. (2017). *Foundations of behavioral research* (4th ed.). Holt.
2. Coolican, H. (2017). *Research methods and statistics in psychology* (7th ed.). Psychology Press.
3. Creswell, J. W. (2018). *Research design* (5th ed.). Sage.
4. Gravetter, F. J., & Forzano, L. A. B. (2020). *Research methods for the behavioral sciences* (6th ed.). Cengage.
5. Shaughnessy, J. J., Zechmeister, E. B., & Zechmeister, J. S. (2019). *Research methods in psychology* (10th ed.). McGraw-Hill.

Reference Books

1. Babbie, E. (2016). *The practice of social research*. Cengage.
2. Breakwell, G. M. (2014). *Research methods in psychology*. Sage.
3. Kazdin, A. E. (2017). *Research design in clinical psychology*. Pearson.
4. Neuman, W. L. (2014). *Social research methods*. Pearson.
5. APA. (2020). *Publication manual of the American Psychological Association* (7th ed.). APA.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Emotional Intelligence & Well-being

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand emotional intelligence concepts
2. To examine emotional competencies and models
3. To relate emotions with mental health
4. To promote personal and social well-being
5. To apply emotional intelligence in life contexts

Course Outcomes

- CO1: Explain emotional intelligence theories
- CO2: Identify emotional competencies
- CO3: Analyze emotions and behaviour
- CO4: Promote psychological well-being
- CO5: Apply emotional intelligence skills

Detailed Syllabus

Unit I
Emotion concepts; nature and functions; emotion components; basic and complex emotions; theories of emotion; cultural influences; emotional expression and regulation.

Unit II
Emotional intelligence models; ability model; mixed models; trait emotional intelligence; assessment tools; competencies; relevance to psychology and mental health.

Unit III
Emotion regulation strategies; coping mechanisms; stress and emotions; resilience; adaptive and maladaptive patterns; emotional balance.

Unit IV
Well-being concepts; subjective well-being; psychological well-being; happiness theories; mindfulness; positive emotions; life satisfaction; mental health promotion.

Unit V
Applications of emotional intelligence; education; workplace; relationships; leadership; counselling contexts; self-development practices.

Text Books

1. Goleman, D. (2015). *Emotional intelligence*. Bantam.

2. Salovey, P., & Mayer, J. D. (1990). *Emotional intelligence*. Imagination, Cognition and Personality.
3. Bar-On, R. (2006). *The Bar-On model of emotional-social intelligence*. Psicothema.
4. Snyder, C. R., & Lopez, S. J. (2018). *Positive psychology*. Sage.
5. Ryff, C. D. (2014). *Psychological well-being*. Journal of Happiness Studies.

Reference Books

1. Gross, J. J. (2015). *Handbook of emotion regulation*. Guilford.
2. Diener, E. (2018). *The science of well-being*. Springer.
3. Fredrickson, B. L. (2013). *Love 2.0*. Penguin.
4. Kabat-Zinn, J. (2015). *Mindfulness*. Hachette.
5. Seligman, M. E. P. (2018). *Flourish*. Free Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Humanities Elective (Ethics / Indian Knowledge Systems)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To introduce ethical reasoning frameworks
2. To understand Indian philosophical traditions
3. To examine values in personal and professional life
4. To relate ethics with psychological practice
5. To promote responsible citizenship

Course Outcomes

- CO1: Explain ethical principles
- CO2: Understand Indian knowledge traditions
- CO3: Analyze ethical dilemmas
- CO4: Apply ethical reasoning
- CO5: Integrate values in practice

Detailed Syllabus

Unit I
Ethics meaning and scope; moral philosophy; values; virtues; ethical reasoning methods; relevance to social sciences.

Unit II
Indian philosophical foundations; Vedic thought; Upanishads; Bhagavad Gita; concepts of self, duty, karma; moral philosophy.

Unit III
Ethical theories; deontology; utilitarianism; virtue ethics; comparative perspectives; contemporary relevance.

Unit IV
Professional ethics; ethics in psychology; confidentiality; competence; responsibility; ethical decision making models.

Unit V
Applied ethics; social responsibility; environmental ethics; digital ethics; citizenship; value-based living.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To provide applied professional exposure
2. To observe psychological practice settings
3. To integrate theory with field experience
4. To develop professional conduct
5. To enhance reflective learning

Course Outcomes

- CO1: Observe professional psychological practices
- CO2: Apply classroom knowledge in field settings
- CO3: Demonstrate ethical behaviour
- CO4: Develop basic professional skills
- CO5: Prepare structured internship reports

Guidelines

Identification of organization; orientation programme; supervised engagement; task allocation; ethical compliance; reflective diary; report preparation; viva-voce examination.

Evaluation Scheme

Internship Report (60%) + Viva-Voce (40%)

SEMESTER IV

Clinical Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand foundations of clinical psychology
2. To examine roles and functions of clinical psychologists
3. To study assessment and diagnostic frameworks
4. To understand therapeutic orientations
5. To relate clinical psychology to mental health services

Course Outcomes

- CO1: Explain scope and history of clinical psychology
- CO2: Understand clinical assessment processes
- CO3: Identify major therapeutic approaches
- CO4: Analyze ethical and professional issues
- CO5: Apply clinical concepts in mental health contexts

Detailed Syllabus

Unit I
Clinical psychology scope; historical development; roles and responsibilities; scientist practitioner model; mental health systems; multidisciplinary teams; professional standards; ethics and regulation.

Unit II
Clinical assessment; intake interviews; case history; mental status examination; psychological testing overview; diagnostic formulation; ICD and DSM systems; cultural considerations.

Unit III
Psychodynamic approaches; behaviour therapy; cognitive therapy; humanistic approaches; integrative models; therapy process; therapeutic alliance; effectiveness considerations.

Unit IV
Psychological interventions; counselling skills; crisis intervention; rehabilitation; prevention programmes; community mental health; referral systems.

Unit V
Ethical and legal issues; confidentiality; informed consent; competence; boundaries; professional conduct; supervision; self care for clinicians.

Text Books

1. Trull, T. J., & Phares, E. J. (2018). *Clinical psychology* (9th ed.). Cengage.
2. Korchin, S. J. (2016). *Modern clinical psychology*. Basic Books.
3. Comer, R. J. (2021). *Abnormal psychology*. Worth.
4. Butcher, J. N. (2019). *Clinical psychology*. Pearson.
5. American Psychiatric Association. (2022). *DSM-5-TR*. APA.

Reference Books

1. Kendell, R. E. (2015). *Clinical psychology*. Oxford University Press.
2. Hersen, M., & Thomas, J. C. (2018). *Handbook of clinical psychology*. Wiley.
3. Corey, G. (2017). *Theory and practice of counseling and psychotherapy*. Cengage.
4. Sadock, B. J., Sadock, V. A., & Ruiz, P. (2017). *Synopsis of psychiatry*. Wolters Kluwer.
5. Pomerantz, A. (2016). *Clinical psychology: Science, practice, and culture*. Sage.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Mental Health Disorders & Interventions

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand major mental health disorders
2. To examine intervention strategies
3. To study psychosocial and pharmacological treatments
4. To understand rehabilitation approaches
5. To relate interventions to mental health outcomes

Course Outcomes

- CO1: Identify major mental health disorders

- CO2: Understand intervention models
- CO3: Analyze treatment approaches
- CO4: Understand rehabilitation strategies
- CO5: Apply intervention knowledge

Detailed Syllabus

Unit I
Mental health concepts; mental illness continuum; epidemiology; classification systems; risk and protective factors; stigma; mental health promotion.

Unit II
Anxiety and mood disorders interventions; psychotherapy approaches; cognitive behavioural techniques; medication overview; combined treatments.

Unit III
Psychotic disorders interventions; antipsychotic treatments; psychosocial interventions; family therapy; community based care.

Unit IV
Substance related and personality disorders; intervention strategies; relapse prevention; counselling approaches; rehabilitation models.

Unit V
Child and adolescent mental health interventions; developmental considerations; school based programmes; prevention and early intervention.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Cognitive Behavioural Approaches

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand foundations of cognitive behavioural therapy
2. To examine cognitive and behavioural techniques
3. To understand case formulation
4. To apply CBT across disorders
5. To understand ethical practice in CBT

Course Outcomes

- CO1: Explain CBT principles
- CO2: Identify cognitive and behavioural techniques
- CO3: Understand CBT case formulation
- CO4: Apply CBT to common disorders
- CO5: Demonstrate ethical CBT practice

Detailed Syllabus

Unit I
Cognitive behavioural therapy foundations; historical development; theoretical assumptions; cognitive model; behavioural principles; evidence base.

Unit II
Assessment and formulation; cognitive conceptualization; goal setting; therapeutic relationship; monitoring progress.

Unit III
Cognitive techniques; identifying automatic thoughts; cognitive restructuring; core beliefs; behavioural experiments.

Unit IV
Behavioural techniques; exposure; relaxation; activity scheduling; skills training; homework assignments.

Unit V
CBT applications; anxiety; depression; stress; relapse prevention; limitations; ethical considerations.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Psychology of Stress, Trauma & Resilience

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand stress and trauma concepts
2. To examine psychological impact of trauma
3. To study coping and resilience mechanisms
4. To understand interventions for stress and trauma
5. To promote resilience and well being

Course Outcomes

- CO1: Explain stress and trauma concepts
- CO2: Identify trauma responses
- CO3: Analyze coping strategies
- CO4: Understand intervention approaches
- CO5: Promote resilience

Detailed Syllabus

Unit I
Stress concepts; stressors; physiological stress response; models of stress; appraisal processes; individual differences.

Unit II
Trauma psychology; types of trauma; acute and chronic trauma; post traumatic stress disorder; risk factors.

Unit III
Coping strategies; problem focused coping; emotion focused coping; maladaptive coping; social support.

Unit IV
Resilience concepts; protective factors; resilience models; post traumatic growth; positive adaptation.

Unit V
Interventions; stress management techniques; trauma focused therapies; community interventions; prevention strategies.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective I (Positive Psychology / Health Psychology)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce positive psychology or health psychology perspectives
2. To examine well being and health behaviour
3. To understand strengths based approaches
4. To promote healthy lifestyles

5. To apply psychological principles to health

Course Outcomes

- CO1: Explain positive or health psychology concepts
- CO2: Understand well being determinants
- CO3: Analyze health behaviour
- CO4: Promote preventive approaches
- CO5: Apply concepts to practice

Detailed Syllabus

Unit I
Positive psychology foundations; strengths; virtues; optimism; happiness; quality of life.

Unit II
Well being models; subjective well being; psychological well being; flourishing; life satisfaction.

Unit III
Health psychology scope; biopsychosocial model; health behaviours; lifestyle factors; stress and health.

Unit IV
Behaviour change models; health promotion; disease prevention; patient adherence; public health relevance.

Unit V
Applications; interventions; workplace well being; community health; policy implications.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Psychology Laboratory / Practicum

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop basic psychological experimentation skills
2. To familiarize psychological tools and tests
3. To enhance observation and data recording skills
4. To apply theoretical concepts practically

5. To develop ethical laboratory practices

Course Outcomes

- CO1: Conduct basic psychological experiments
- CO2: Administer simple psychological tests
- CO3: Record and analyze behavioural data
- CO4: Interpret experimental findings
- CO5: Demonstrate ethical lab conduct

List of Experiments / Exercises

1. Measurement of attention and concentration using standardized psychological apparatus, including administration procedures, scoring methods, and interpretation of individual differences in attentional performance.
2. Assessment of memory using verbal and non verbal memory tests, focusing on encoding, retention, recall processes, and systematic recording of results.
3. Experiment on learning using paired associate or maze learning tasks, emphasizing acquisition curves, error analysis, and learning efficiency.
4. Intelligence assessment using standardized intelligence scales, including rapport building, test administration, scoring accuracy, and ethical considerations.
5. Personality assessment using objective personality inventories, interpretation of profiles, response patterns, and limitations of assessment tools.
6. Experiment on reaction time using laboratory equipment or computer based tasks, measurement accuracy, and analysis of sensory motor coordination.
7. Perception experiment on illusion or depth perception, focusing on perceptual organization principles and individual variability.
8. Study of emotional states using rating scales or inventories, emphasizing self report measures, scoring, and interpretation.
9. Stress assessment using standardized stress scales, understanding stress indicators, and ethical handling of sensitive data.
10. Observation based behavioural study in controlled settings, development of observation schedules, recording techniques, and basic behavioural analysis.
11. Case based practical exercise on psychological assessment report writing, focusing on structure, clarity, and professional presentation.
12. Viva voce examination covering laboratory experiments, ethical practices, and application of psychological principles.

Expected Outcomes

Hands on experience in psychological experimentation; familiarity with testing tools; development of data handling and reporting skills; application of theory to practice; adherence to ethical standards.

Evaluation Scheme

Continuous Assessment (60%) + End-Semester Practical Examination (40%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To provide supervised clinical or community exposure
2. To observe applied psychological practices
3. To integrate academic learning with field work
4. To develop professional ethics
5. To enhance reflective practice

Course Outcomes

- CO1: Observe mental health service delivery
- CO2: Apply psychological knowledge in practice
- CO3: Demonstrate ethical conduct
- CO4: Develop basic professional skills
- CO5: Prepare structured internship documentation

Guidelines

Identification of approved organization; orientation programme; supervised engagement; task allocation; ethical compliance; reflective diary maintenance; report submission; viva voce.

Evaluation Scheme

Internship Report (60%) + Viva-Voce (40%)

SEMESTER V

Counselling Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand foundations and scope of counselling psychology
2. To examine counselling theories and approaches
3. To develop basic counselling skills and techniques
4. To understand counselling process and ethics
5. To relate counselling psychology to mental health practice

Course Outcomes

- CO1: Explain principles of counselling psychology
- CO2: Identify major counselling approaches
- CO3: Demonstrate basic counselling skills
- CO4: Understand ethical counselling practices
- CO5: Apply counselling concepts to life situations

Detailed Syllabus

Unit I
Counselling psychology scope; historical development; goals and functions; counsellor roles; personal qualities; counselling settings; professional standards; ethical foundations; cultural sensitivity.

Unit II
Counselling process; intake; rapport building; assessment overview; goal setting; counselling relationship; stages of counselling; termination and follow up.

Unit III
Psychodynamic counselling; person centred counselling; behavioural counselling; cognitive behavioural counselling; theoretical assumptions; techniques; comparative perspectives.

Unit IV
Counselling skills; attending; listening; empathy; questioning; reflection; summarizing; handling resistance; crisis intervention basics.

Unit V
Ethical issues; confidentiality; informed consent; boundaries; competence; referral; supervision; self care; professional development.

Text Books

1. Corey, G. (2017). *Theory and practice of counseling and psychotherapy* (10th ed.). Cengage.
2. Gladding, S. T. (2018). *Counseling: A comprehensive profession* (8th ed.). Pearson.
3. McLeod, J. (2013). *An introduction to counselling* (5th ed.). Open University Press.
4. Feltham, C., & Dryden, W. (2014). *Dictionary of counselling*. Sage.
5. Gibson, R. L., & Mitchell, M. H. (2016). *Introduction to counseling and guidance*. Pearson.

Reference Books

1. Egan, G. (2014). *The skilled helper*. Cengage.
2. Nelson-Jones, R. (2015). *Basic counselling skills*. Sage.
3. Geldard, D., & Geldard, K. (2018). *Counselling skills in everyday life*. Sage.
4. Bond, T. (2015). *Ethics and values in counselling*. Sage.
5. Sue, D. W., & Sue, D. (2016). *Counseling the culturally diverse*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Organizational Behaviour & Industrial Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand behaviour in organizational settings
2. To examine psychological principles at workplace
3. To study motivation, leadership, and groups
4. To understand employee well being and performance
5. To relate psychology to organizational effectiveness

Course Outcomes

- CO1: Explain organizational behaviour concepts

- CO2: Analyze individual behaviour at workplace
- CO3: Understand motivation and leadership
- CO4: Examine group and organizational processes
- CO5: Apply industrial psychology principles

Detailed Syllabus

Unit I
Industrial and organizational psychology scope; historical development; relevance to organizations; work behaviour; individual differences; job analysis.

Unit II
Motivation theories; need based theories; process theories; job satisfaction; work attitudes; employee engagement.

Unit III
Leadership concepts; leadership theories; power and influence; communication; decision making; managerial effectiveness.

Unit IV
Group behaviour; teams; group dynamics; conflict; negotiation; organizational culture; climate; change.

Unit V
Employee well being; stress at work; work life balance; performance appraisal; training and development; organizational effectiveness.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Mental Health Promotion & Community Psychology

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand community psychology principles
2. To examine mental health promotion strategies
3. To understand preventive and promotive approaches
4. To relate psychology to community development
5. To apply community based mental health practices

Course Outcomes

- CO1: Explain community psychology concepts
- CO2: Identify mental health promotion strategies
- CO3: Understand prevention approaches
- CO4: Analyze community interventions
- CO5: Apply community psychology principles

Detailed Syllabus

Unit I
Community psychology scope; principles; empowerment; prevention; social justice; ecological perspectives; community mental health.

Unit II
Mental health promotion; determinants of mental health; protective factors; resilience; life skills education.

Unit III
Prevention strategies; primary, secondary, tertiary prevention; risk reduction; early intervention; vulnerable populations.

Unit IV
Community interventions; programme planning; implementation; evaluation; stakeholder participation; advocacy.

Unit V
Mental health policies; national mental health programmes; role of NGOs; community participation; future directions.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Cognitive Science Applications (AI, UX, Human Factors)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand applied aspects of cognitive science
2. To examine human computer interaction principles
3. To understand cognitive aspects of artificial intelligence
4. To study user experience and human factors
5. To apply cognitive science in real world systems

Course Outcomes

- CO1: Explain cognitive science applications
- CO2: Understand AI and cognition interface
- CO3: Analyze human computer interaction
- CO4: Apply user experience principles
- CO5: Evaluate human factors in design

Detailed Syllabus

Unit I
Applied cognitive science overview; cognition in real world systems; interdisciplinary applications; design thinking relevance.

Unit II
Artificial intelligence basics; cognitive architectures; machine learning overview; human versus artificial cognition.

Unit III
Human computer interaction; perception and usability; interface design principles; cognitive load; error analysis.

Unit IV
User experience design; user research; usability testing; accessibility; inclusive design principles.

Unit V
Human factors; ergonomics; system safety; performance; decision making in complex systems; applied case studies.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Elective I (Child Psychology / Geriatric Psychology)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand specialized population psychology
2. To examine developmental and mental health issues
3. To study assessment and intervention approaches
4. To understand care and support systems

5. To apply psychological knowledge to practice

Course Outcomes

- CO1: Explain child or geriatric psychology concepts
- CO2: Identify developmental challenges
- CO3: Understand assessment approaches
- CO4: Analyze intervention strategies
- CO5: Apply knowledge to professional contexts

Detailed Syllabus

Unit I
Child or aging development overview; biological, cognitive, emotional changes; contextual influences.

Unit II
Psychological issues; behavioural problems; emotional disorders; cognitive decline; risk factors.

Unit III
Assessment approaches; developmental assessment; screening tools; observational methods; ethical considerations.

Unit IV
Intervention strategies; counselling; behavioural interventions; family involvement; care models.

Unit V
Policy and support systems; child welfare; elder care services; rehabilitation; quality of life.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project (Psychological Case Study / Survey Research)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To develop basic research skills
2. To apply psychological concepts in research
3. To conduct supervised case study or survey

4. To develop academic writing skills
5. To prepare for major project

Course Outcomes

- CO1: Identify research problem
- CO2: Collect and analyze data
- CO3: Apply ethical research practices
- CO4: Prepare structured project report
- CO5: Present research findings

Guidelines

Topic selection; proposal approval; research design; data collection; analysis; report writing; supervision; presentation; evaluation.

Evaluation Scheme

Project Report (70%) + Presentation and Viva-Voce (30%)

SEMESTER VI

Psychopathology & Diagnostic Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand foundations of psychopathology
2. To examine diagnostic classification systems
3. To analyze symptom patterns across disorders
4. To understand diagnostic decision processes
5. To relate diagnosis with mental health practice

Course Outcomes

- CO1: Explain psychopathology concepts
- CO2: Understand diagnostic classification systems
- CO3: Identify symptom clusters
- CO4: Apply diagnostic criteria
- CO5: Analyze limitations of diagnosis

Detailed Syllabus

Unit I
Psychopathology foundations; concepts of mental illness; historical perspectives; cultural considerations; dimensional and categorical approaches; clinical judgement.

Unit II
Diagnostic systems overview; ICD and DSM frameworks; structure; classification principles; multiaxial concepts; revisions and updates.

Unit III
Assessment and diagnosis; clinical interviews; symptom evaluation; differential diagnosis; comorbidity; reliability and validity issues.

Unit IV
Major diagnostic categories; mood disorders; anxiety disorders; psychotic disorders; personality disorders; neurodevelopmental disorders.

Unit V
Contemporary issues; cultural formulation; stigma; over diagnosis; ethical challenges; future directions in diagnostic practice.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Ethics, Law & Professional Practice in Psychology

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand ethical principles in psychology
2. To examine legal frameworks affecting practice
3. To understand professional standards and conduct
4. To analyze ethical dilemmas
5. To promote responsible professional practice

Course Outcomes

- CO1: Explain ethical principles
- CO2: Understand legal responsibilities
- CO3: Apply professional codes
- CO4: Analyze ethical dilemmas
- CO5: Demonstrate ethical decision making

Detailed Syllabus

Unit I
Ethics foundations; moral principles; autonomy; beneficence; non maleficence; justice; ethical reasoning models.

Unit II
Professional ethics in psychology; codes of conduct; confidentiality; informed consent; competence; boundaries.

Unit III
Legal aspects; mental health legislation; rights of clients; forensic considerations; record keeping; liability.

Unit IV
Ethical dilemmas; dual relationships; cultural issues; research ethics; technology and ethics.

Unit V
Professional practice; supervision; self care; continuing professional development; ethical practice in Indian context.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Emerging Trends in Psychology & Cognitive Science

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand contemporary developments
2. To examine interdisciplinary trends
3. To analyze technology driven psychology
4. To understand future research directions
5. To integrate emerging knowledge

Course Outcomes

- CO1: Identify emerging trends
- CO2: Understand interdisciplinary integration
- CO3: Analyze technology applications
- CO4: Evaluate contemporary research
- CO5: Integrate new perspectives

Detailed Syllabus

Unit I
Contemporary psychology overview; paradigm shifts; interdisciplinary integration; global mental health perspectives.

Unit II
Neuroscience advances; neuroimaging developments; brain stimulation techniques; neurotechnology applications.

Unit III
Digital psychology; telepsychology; mental health apps; artificial intelligence in assessment and intervention.

Unit IV
Cognitive science frontiers; embodied cognition; social cognition; affective neuroscience; computational models.

Unit V
Future directions; ethical challenges; policy implications; research opportunities; professional competencies.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Open Elective II (Neuropsychology / Addiction Studies)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand specialized applied psychology areas
2. To examine brain behaviour relationships or addiction
3. To study assessment and intervention approaches
4. To understand rehabilitation perspectives
5. To apply elective knowledge

Course Outcomes

- CO1: Explain neuropsychology or addiction concepts
- CO2: Understand assessment approaches
- CO3: Analyze intervention strategies
- CO4: Understand rehabilitation models
- CO5: Apply knowledge in practice

Detailed Syllabus

Unit I
Neuropsychology or addiction studies scope; historical background; relevance to mental health.

Unit II
Brain structures and functions or substance use patterns; neurobiological mechanisms.

Unit III
Assessment methods; neuropsychological tests or addiction screening tools; ethical issues.

Unit IV
Intervention strategies; rehabilitation; counselling; relapse prevention.

Unit V
Policy; prevention; community programmes; future directions.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Major Project (Research / Field-Based Study)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. To conduct independent psychological research
2. To integrate theory and methodology
3. To apply ethical research practices
4. To develop analytical and writing skills
5. To demonstrate professional competence

Course Outcomes

- CO1: Formulate research problem
- CO2: Design and conduct study
- CO3: Analyze and interpret data
- CO4: Prepare comprehensive dissertation
- CO5: Defend research findings

Guidelines

Proposal approval; research design; data collection; analysis; dissertation writing; supervision; plagiarism check; submission protocol.

Evaluation Scheme

Dissertation (70%) + Viva-Voce (30%)

Seminar / Viva-Voce

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To develop academic presentation skills
2. To enhance critical thinking
3. To improve scholarly communication
4. To evaluate subject mastery
5. To prepare for professional transition

Course Outcomes

- CO1: Present seminar effectively
- CO2: Demonstrate subject understanding
- CO3: Engage in academic discussion
- CO4: Apply critical analysis
- CO5: Perform in viva voce examination

Guidelines

Seminar topic approval; literature review; presentation schedule; evaluation rubrics; viva voce examination.

Evaluation Scheme

Seminar Presentation (50%) + Viva-Voce (50%)

B.A. – Fashion Designing (Digital Fashion)

Duration: 3 Years | 6 SEMESTER s | Total Credits: 120

SEMESTER I

Fundamentals of Fashion Design

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamental concepts of fashion design
2. Develop design sensitivity and visual awareness
3. Apply design fundamentals to apparel concepts
4. Interpret fashion design processes systematically
5. Build foundational vocabulary for fashion design practice

Course Outcomes

- CO1: Identify core fashion design concepts
- CO2: Apply design fundamentals in apparel contexts
- CO3: Analyze fashion design processes
- CO4: Interpret functional and aesthetic requirements
- CO5: Develop basic fashion design compositions

Detailed Syllabus

Unit I: Fashion design definition, scope, terminology; apparel categories, functions; designer roles, responsibilities; fashion cycles, seasonal classifications; design process stages, inspiration sources; consumer needs, functional, aesthetic, psychological considerations; basic understanding of fashion industry structure, design workflow, professional ethics.

Unit II: Elements of fashion design; line types, direction, thickness; shapes, forms, silhouettes; texture, fabric surface qualities; color basics; visual impact in garments; relationship between elements; application in apparel sketches; balance between form, function, and aesthetics in design development.

Unit III: Principles of fashion design; balance, proportion, rhythm, emphasis; harmony, unity, contrast; scale relationships; application in garment composition; visual weight distribution;

focal points; design coherence; suitability for body types; adaptation of principles in contemporary fashion products.

Unit IV: Design inspiration sources; nature, architecture, art, culture; historical references; market trends; mood boards, concept boards; theme development; idea translation into apparel concepts; creative thinking frameworks; originality, innovation, relevance within fashion design practice.

Unit V: Introduction to fashion collections; concept planning; design coordination; basic collection structure; color stories; fabric selection rationale; silhouette consistency; target customer profiling; design documentation; presentation basics; professional communication of fashion design ideas.

Text Books

1. Seivewright, S. (2012). *Basics Fashion Design 01: Research and Design*. AVA Publishing.
2. Hopkins, J. (2011). *Fashion Design: The Complete Guide*. AVA Publishing.
3. Gini Stephens Frings. (2014). *Fashion: From Concept to Consumer*. Pearson Education.
4. Renfrew, E., & Renfrew, C. (2014). *Developing a Collection*. Palgrave Macmillan.
5. Tate, S. L. (2018). *Inside Fashion Design*. Pearson Education.

Reference Books

1. Jackson, T. (2015). *Fashion Design*. Laurence King Publishing.
2. Burns, L. D., & Bryant, N. O. (2007). *The Business of Fashion*. Fairchild Books.
3. Wolfe, M. (2013). *Fashion Design Essentials*. Cengage Learning.
4. Stecker, P. (2016). *Fashion Design Course*. Barron's Educational Series.
5. Hodge, S. (2018). *Fashion Design: The Complete Guide*. Thames & Hudson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Elements & Principles of Design

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand visual design fundamentals

2. Analyze elements and principles relationships
3. Apply design theory to fashion contexts
4. Develop visual composition skills
5. Enhance aesthetic judgment abilities

Course Outcomes

- CO1: Identify elements of design
- CO2: Apply principles in visual compositions
- CO3: Analyze design effectiveness
- CO4: Integrate theory with fashion applications
- CO5: Create balanced design layouts

Detailed Syllabus

Unit I: Elements of design overview; line characteristics, expressive qualities; shape classification, geometric, organic; form perception; texture types, visual, tactile; space, positive, negative; color introduction; relevance of elements in fashion and textile design applications.

Unit II: Principles of design fundamentals; balance types, symmetry, asymmetry; proportion, scale relationships; rhythm creation; movement direction; emphasis techniques; focal point development; unity concepts; application in apparel layouts and fashion visuals.

Unit III: Color theory basics; color wheel, primary, secondary, tertiary; hue, value, intensity; warm, cool colors; color harmony schemes; contrast effects; psychological color impact; color application in garments, textiles, and fashion communication.

Unit IV: Texture and surface design; fabric textures; visual interest creation; tactile perception; pattern repetition; motif development; surface embellishment basics; relationship between texture and form; functional and aesthetic considerations in apparel design.

Unit V: Design composition analysis; visual balance evaluation; proportion correction; harmony assessment; contrast optimization; design critique methods; application exercises; integration of elements and principles; relevance to contemporary fashion design practices.

Text Books

1. Wong, W. (2012). *Principles of Form and Design*. John Wiley & Sons.
2. Ocvirk, O. G., et al. (2015). *Art Fundamentals*. McGraw-Hill Education.
3. Lauer, D. A., & Pentak, S. (2016). *Design Basics*. Cengage Learning.
4. Stewart, M. (2011). *LaunchPad for Design*. McGraw-Hill.

5. Zelanski, P., & Fisher, M. P. (2010). *Design Principles and Problems*. Cengage Learning.

Reference Books

1. Pipes, A. (2014). *Foundations of Art and Design*. Laurence King.
2. Samara, T. (2017). *Design Elements*. Rockport Publishers.
3. Evans, P., & Thomas, M. (2013). *Exploring the Elements of Design*. Cengage.
4. Heller, S. (2015). *Design Literacy*. Allworth Press.
5. Lidwell, W., et al. (2010). *Universal Principles of Design*. Rockport.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Textile Science – I (Natural Fibres & Fabrics)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand natural fibre properties
2. Identify textile fibre classifications
3. Analyze fabric structures
4. Relate fibre properties to apparel use
5. Develop basic textile evaluation skills

Course Outcomes

- CO1: Classify natural fibres
- CO2: Explain fibre properties
- CO3: Analyze fabric structures
- CO4: Select fibres for apparel applications
- CO5: Evaluate textile performance characteristics

Detailed Syllabus

Unit I: Textile science introduction; fibre definition, classification; natural fibres overview; plant, animal, mineral fibres; fibre morphology concepts; basic terminology; importance of textiles in fashion; relationship between fibres, yarns, fabrics, apparel products.

Unit II: Plant fibres study; cotton characteristics, cultivation; fibre structure, properties; flax, linen overview; jute basics; physical, chemical properties; advantages, limitations; applications in apparel and home textiles; sustainability considerations.

Unit III: Animal fibres study; wool types, structure; silk varieties, production; fibre properties; thermal behavior; elasticity; moisture absorption; care requirements; applications in garments; luxury textiles overview.

Unit IV: Fabric formation basics; yarn concepts; spinning overview; weaving fundamentals; knit structures introduction; nonwoven basics; fabric properties influence; relationship between structure and performance in apparel usage.

Unit V: Fabric performance evaluation; durability, comfort; breathability; drape; handle; shrinkage; care labeling basics; fibre identification methods; microscopic, burn tests; relevance to fashion design decision-making.

Text Books

1. Corbman, B. P. (2011). *Textiles: Fiber to Fabric*. McGraw-Hill.
2. Kadolph, S. J. (2013). *Textiles*. Pearson Education.
3. Tortora, P. G., & Merkel, R. S. (2009). *Fairchild's Textiles*. Fairchild Books.
4. Joseph, M. L. (2010). *Essentials of Textiles*. Holt, Rinehart and Winston.
5. Sinclair, R. (2015). *Textiles and Fashion*. Woodhead Publishing.

Reference Books

1. Booth, J. E. (2014). *Principles of Textile Testing*. Butterworth-Heinemann.
2. Morton, W. E., & Hearle, J. W. S. (2008). *Physical Properties of Textile Fibres*. Woodhead.
3. Cook, J. G. (2012). *Handbook of Textile Fibres*. Woodhead.
4. Nayak, R., & Padhye, R. (2017). *Textiles and Fashion*. Woodhead.
5. Saville, B. (2011). *Physical Testing of Textiles*. Woodhead.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Basics of Drawing & Fashion Illustration

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop basic drawing skills
2. Understand human proportions
3. Practice fashion illustration techniques
4. Enhance visual communication
5. Apply drawing skills to fashion concepts

Course Outcomes

- CO1: Draw basic forms and figures
- CO2: Apply proportion principles
- CO3: Create basic fashion illustrations
- CO4: Communicate design ideas visually
- CO5: Develop illustration confidence

Detailed Syllabus

Unit I: Drawing fundamentals; line quality; hand control; basic shapes; geometric forms; shading basics; perspective introduction; observation skills; visual representation techniques; relevance of drawing in fashion design communication.

Unit II: Human anatomy basics; body proportions; fashion figure standards; balance, posture; movement indication; skeletal reference; simplified body structures; adaptation for fashion illustration purposes.

Unit III: Fashion figure development; croquis creation; stylization techniques; elongation methods; poses; front, side, back views; consistency in proportions; practice exercises for apparel visualization.

Unit IV: Garment illustration basics; fabric fall; folds, pleats; drape representation; texture indication; detailing seams, darts; collars, sleeves; garment components visualization techniques.

Unit V: Introduction to fashion sketching; concept sketches; flat sketches basics; line drawings; annotation methods; presentation clarity; integration of drawing with design development process.

Text Books

1. Bina Abling. (2018). *Fashion Sketchbook*. Fairchild Books.

2. Drake, J. (2016). *Drawing for Fashion Design*. Laurence King.
3. Hogben, L. (2015). *Fashion Design Drawing Course*. Barron's.
4. Richardson, C. (2014). *Drawing and Illustration for Fashion Design*. Laurence King.
5. Goldstein, N. (2012). *Fashion Illustration*. Fairchild.

Reference Books

1. Seaman, K. (2017). *Fashion Illustration*. Bloomsbury.
2. Kiper, A. (2015). *Fashion Illustration Techniques*. Fairchild.
3. McKelvey, K., & Munslow, J. (2012). *Fashion Drawing and Illustration*. Wiley.
4. Sorger, R., & Udale, J. (2017). *The Fundamentals of Fashion Design*. Bloomsbury.
5. Tain, L. (2014). *Fashion Illustration Basics*. AVA Publishing.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

History of Fashion & Costume

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand historical fashion evolution
2. Identify costume characteristics by era
3. Relate fashion history to contemporary design
4. Analyze cultural influences on dress
5. Build historical reference knowledge

Course Outcomes

- CO1: Identify major fashion periods
- CO2: Describe costume features historically
- CO3: Analyze cultural fashion influences
- CO4: Apply historical references creatively
- CO5: Develop contextual fashion understanding

Detailed Syllabus

Unit I: Introduction to costume history; importance of fashion history; sources of historical study; ancient civilizations overview; Egyptian, Greek, Roman costumes; silhouettes, materials, accessories; social and cultural influences on dress.

Unit II: Medieval and Renaissance costume; European fashion development; garments, layers; fabrics, ornamentation; gender distinctions; influence of art, religion; transition of silhouettes; historical significance.

Unit III: Seventeenth and eighteenth century fashion; Baroque, Rococo styles; court dress; elaborate silhouettes; fabrics, embellishments; accessories; impact of monarchy and social hierarchy on fashion trends.

Unit IV: Nineteenth century fashion; Industrial Revolution impact; Victorian era dress; crinolines, bustles; menswear evolution; technological influence; social change reflection in costume development.

Unit V: Twentieth century fashion overview; major style movements; designers influence; cultural shifts; wartime effects; modernization; foundation for contemporary fashion understanding.

Text Books

1. Tortora, P. G., & Eubank, K. (2010). *Survey of Historic Costume*. Fairchild.
2. Laver, J. (2012). *Costume and Fashion*. Thames & Hudson.
3. Boucher, F. (2011). *A History of Costume in the West*. Thames & Hudson.
4. Peacock, J. (2013). *Fashion Sourcebooks*. Thames & Hudson.
5. Steele, V. (2015). *Fashion and History*. Yale University Press.

Reference Books

1. Cosgrave, B. (2012). *The Complete History of Costume*. Checkmark.
2. Ribeiro, A. (2016). *Dress and Morality*. Berg.
3. Wilcox, R. T. (2008). *The Mode in Costume*. Scribner.
4. Payne, B. (2011). *History of Costume*. HarperCollins.
5. Vincent, S. (2018). *The Anatomy of Fashion*. Berg.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Improve English language proficiency
2. Develop professional communication skills
3. Enhance listening and speaking abilities
4. Strengthen reading and writing competence
5. Build workplace communication confidence

Course Outcomes

- CO1: Use English effectively
- CO2: Communicate professionally
- CO3: Demonstrate presentation skills
- CO4: Apply writing skills
- CO5: Engage in professional interactions

Detailed Syllabus

Unit I: Communication basics; verbal, nonverbal communication; barriers; listening skills; pronunciation basics; phonetics introduction; stress, intonation; effective interpersonal communication in academic and professional contexts.

Unit II: Grammar fundamentals; sentence structures; tenses; parts of speech; common errors; vocabulary building; word usage; functional English for professional communication.

Unit III: Reading skills; comprehension strategies; skimming, scanning; technical texts; vocabulary enrichment; contextual understanding; interpretation skills; relevance to academic study.

Unit IV: Writing skills; paragraph construction; formal letters; emails; reports basics; resume writing; clarity, coherence; professional documentation standards.

Unit V: Speaking skills; group discussions; presentations; interviews; public speaking basics; confidence building; body language; professional etiquette.

Text Books

1. Murphy, R. (2016). *English Grammar in Use*. Cambridge University Press.
2. Eastwood, J. (2011). *Oxford Practice Grammar*. Oxford University Press.
3. Thomson, A. J., & Martinet, A. V. (2014). *A Practical English Grammar*. Oxford.

4. Comfort, J., et al. (2015). *English for the Workplace*. Cambridge.
5. Raman, M., & Sharma, S. (2017). *Technical Communication*. Oxford.

Reference Books

1. Hewings, M. (2013). *Advanced Grammar in Use*. Cambridge.
2. Bailey, S. (2015). *Academic Writing*. Routledge.
3. Leech, G. (2014). *A Communicative Grammar of English*. Pearson.
4. Guffey, M. E. (2016). *Business Communication*. Cengage.
5. Carter, R. (2012). *Cambridge Grammar of English*. Cambridge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Design Studio – I

Course Category: Core Engineering Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Apply basic design concepts practically
2. Develop creative exploration skills
3. Practice visual experimentation
4. Translate ideas into design outcomes
5. Build foundational studio discipline

Course Outcomes

- CO1: Apply design fundamentals practically
- CO2: Develop creative concepts
- CO3: Execute basic design tasks
- CO4: Present studio work effectively
- CO5: Demonstrate process-oriented thinking

List of Experiments / Exercises *(10 Experiments)*

1. Visual exploration of lines, shapes, and textures using manual media, focusing on composition control and creative interpretation.

2. Creation of element-based design sheets using lines, forms, and textures to develop visual awareness and design sensitivity.
3. Color application exercises using basic harmony schemes, emphasizing balance, contrast, and visual impact.
4. Theme-based mood board development using visual references, color palettes, and material samples.
5. Translation of abstract concepts into simple apparel design ideas using sketching techniques.
6. Fabric texture study through observation, documentation, and surface representation exercises.
7. Basic silhouette exploration using cut-paper techniques to understand form and proportion.
8. Design principle application exercises focusing on balance, rhythm, and emphasis.
9. Concept development exercise from inspiration source to initial design visualization.
10. Final studio presentation compiling exercises with reflective documentation and visual communication focus.

Expected Outcomes

Application of design fundamentals; creative exploration; improved visual communication; foundational studio practice skills.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER II

Fashion Illustration & Rendering Techniques

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced fashion illustration skills
2. Understand rendering tools and media
3. Apply color techniques in fashion visuals
4. Enhance garment detailing representation
5. Strengthen professional presentation ability

Course Outcomes

- CO1: Create proportionate fashion figures
- CO2: Apply rendering techniques effectively
- CO3: Illustrate garments with fabric realism
- CO4: Use color media appropriately
- CO5: Present professional fashion illustrations

Detailed Syllabus

Unit I: Advanced fashion figure development; dynamic poses, movement balance; croquis refinement; proportion control; male, female figure variations; expressive posture; alignment accuracy; adaptation for different apparel categories; consistency across illustration series.

Unit II: Garment rendering fundamentals; fabric behavior depiction; folds, drapes, pleats; light, shadow relationships; texture simulation; surface quality representation; volume perception; visual depth creation; material-specific illustration techniques.

Unit III: Color media techniques; pencils, watercolors, markers; blending methods; tonal variation; highlights, shadows; color harmony application; fabric transparency effects; reflective surfaces; controlled rendering for fashion visuals.

Unit IV: Detailing techniques; seams, darts, fasteners; collars, sleeves, trims; embellishment illustration; embroidery representation; prints, patterns; scale accuracy; technical clarity in fashion drawings.

Unit V: Presentation layouts; portfolio composition; background treatments; annotation standards; concept labeling; visual storytelling; professional illustration formats; coherence between theme, garment, and rendering style.

Text Books

1. Bina Abling. (2018). *Fashion Illustration: Studio Access Card*. Fairchild Books.
2. Drake, J. (2016). *Drawing for Fashion Design*. Laurence King.
3. Richardson, C. (2014). *Drawing and Illustration for Fashion Design*. Laurence King.
4. Goldstein, N. (2012). *Fashion Illustration*. Fairchild Books.
5. Hogben, L. (2015). *Fashion Design Drawing Course*. Barron's.

Reference Books

1. Seaman, K. (2017). *Fashion Illustration*. Bloomsbury.
2. McKelvey, K., & Munslow, J. (2012). *Fashion Drawing and Illustration*. Wiley.
3. Sorger, R., & Udale, J. (2017). *The Fundamentals of Fashion Design*. Bloomsbury.
4. Tain, L. (2014). *Fashion Illustration Basics*. AVA Publishing.
5. Kiper, A. (2015). *Fashion Illustration Techniques*. Fairchild.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Textile Science – II (Man-Made & Blended Fabrics)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand man-made fibre classifications
2. Study properties of synthetic fibres
3. Analyze blended fabric characteristics
4. Relate fibre properties to end-use
5. Develop textile selection competence

Course Outcomes

- CO1: Classify man-made fibres
- CO2: Explain fibre manufacturing concepts
- CO3: Analyze blended fabrics
- CO4: Select fabrics for apparel use

- CO5: Evaluate textile performance

Detailed Syllabus

Unit I: Man-made fibres overview; classification; polymer basics; fibre formation concepts; regeneration, synthesis; importance in fashion industry; comparison with natural fibres; advantages, limitations; sustainability perspectives.

Unit II: Regenerated fibres study; rayon, viscose; fibre structure; properties; performance characteristics; applications; care requirements; comfort behavior; apparel usage suitability; environmental considerations.

Unit III: Synthetic fibres study; polyester, nylon, acrylic; fibre morphology; strength, elasticity; moisture behavior; thermal properties; durability; applications in fashion and technical textiles.

Unit IV: Blended fabrics; blending objectives; fibre compatibility; blend ratios; yarn blending, fabric blending; performance enhancement; aesthetic improvement; cost effectiveness; common apparel blends.

Unit V: Fabric performance analysis; wrinkle resistance; abrasion; pilling; static behavior; comfort properties; care labeling; end-use selection criteria; relevance to design decision-making.

Text Books

1. Tortora, P. G., & Merkel, R. S. (2009). *Fairchild's Textiles*. Fairchild Books.
2. Kadolph, S. J. (2013). *Textiles*. Pearson Education.
3. Corbman, B. P. (2011). *Textiles: Fiber to Fabric*. McGraw-Hill.
4. Joseph, M. L. (2010). *Essentials of Textiles*. Holt.
5. Sinclair, R. (2015). *Textiles and Fashion*. Woodhead.

Reference Books

1. Booth, J. E. (2014). *Principles of Textile Testing*. Butterworth-Heinemann.
2. Morton, W. E., & Hearle, J. W. S. (2008). *Physical Properties of Textile Fibres*. Woodhead.
3. Saville, B. (2011). *Physical Testing of Textiles*. Woodhead.
4. Nayak, R., & Padhye, R. (2017). *Textiles and Fashion*. Woodhead.
5. Cook, J. G. (2012). *Handbook of Textile Fibres*. Woodhead.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Garment Construction – I

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand garment construction fundamentals
2. Learn basic sewing techniques
3. Study seams and finishes
4. Apply construction methods practically
5. Develop apparel assembly skills

Course Outcomes

- CO1: Identify garment components
- CO2: Apply basic stitching techniques
- CO3: Construct simple garments
- CO4: Analyze construction quality
- CO5: Demonstrate safe machine handling

Detailed Syllabus

Unit I: Introduction to garment construction; tools, equipment; sewing machines; machine parts; safety practices; basic stitches; stitch classification; thread properties; fabric preparation techniques.

Unit II: Seams classification; plain, French, flat-felled seams; seam finishes; hems, facings; edge finishes; functional, decorative purposes; application suitability for fabrics.

Unit III: Garment components; plackets, openings; fasteners; sleeves basics; collars introduction; cuffs; waistband concepts; construction sequence understanding.

Unit IV: Measurement basics; body measurements; size charts; ease allowance; garment balance; fitting principles; quality control basics in construction.

Unit V: Construction of basic garments; skirts, tops; assembly steps; pressing techniques; finishing standards; evaluation criteria; workmanship assessment.

Text Books

1. Cooklin, G. (2014). *Garment Technology for Fashion Designers*. Wiley.
2. Marsh, J. (2016). *The Fashion Designer's Manual*. Wiley.
3. Aldrich, W. (2015). *Metric Pattern Cutting*. Wiley.

4. Reader's Digest. (2011). *Complete Guide to Sewing*. Reader's Digest.
5. Shaeffer, C. (2011). *Sewing for the Apparel Industry*. Fairchild.

Reference Books

1. Anikweze, G. U. (2012). *Garment Construction*. Evans Brothers.
2. Fairhurst, C. (2013). *Textiles in Fashion*. Blackwell.
3. Hollen, N., & Kundel, M. (2010). *Pattern Making by the Flat-Pattern Method*. Pearson.
4. Armstrong, H. J. (2014). *Patternmaking for Fashion Design*. Pearson.
5. Cooklin, G. (2006). *Introduction to Clothing Manufacture*. Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Colour Theory & Trend Studies

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand colour theory principles
2. Analyze colour psychology
3. Study fashion trend mechanisms
4. Apply colour in design planning
5. Interpret trend information

Course Outcomes

- CO1: Apply colour theory concepts
- CO2: Analyze colour harmonies
- CO3: Interpret fashion trends
- CO4: Develop colour stories
- CO5: Integrate trends into design

Detailed Syllabus

Unit I: Colour theory fundamentals; colour wheel; primary, secondary, tertiary colours; hue, value, intensity; warm, cool colours; colour perception basics; relevance in fashion design.

Unit II: Colour harmony schemes; monochromatic, analogous, complementary; contrast effects; balance; proportion; psychological impact of colours; cultural associations in apparel.

Unit III: Fashion trend basics; trend definition; forecasting concepts; short-term, long-term trends; trend cycles; sources of trend information; fashion capitals influence.

Unit IV: Trend analysis methods; mood boards; colour forecasting; seasonal palettes; consumer behavior influence; market segmentation; lifestyle trends relevance.

Unit V: Application of colour and trends; collection planning; colour stories; coordination; visual consistency; design relevance; commercial viability assessment.

Text Books

1. Stone, T. L. (2017). *A Field Guide to Color*. Rockport.
2. Edwards, B. (2014). *Color and Design*. Pearson.
3. Brannon, E. L. (2010). *Fashion Forecasting*. Fairchild.
4. Clarke, S. (2012). *Colour*. Laurence King.
5. Jackson, T. (2015). *Fashion Trends*. Laurence King.

Reference Books

1. Eiseman, L. (2017). *Pantone Guide to Communicating with Color*. Wiley.
2. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.
3. Solomon, M. (2014). *Consumer Behavior*. Pearson.
4. Burns, L. D. (2011). *The Business of Fashion*. Fairchild.
5. Posner, H. (2015). *Marketing Fashion*. Laurence King.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Introduction to Digital Design Tools

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand digital design fundamentals
2. Learn basic graphic software tools
3. Apply digital techniques to fashion
4. Develop digital visualization skills

5. Integrate technology in design process

Course Outcomes

- CO1: Use basic digital tools
- CO2: Create digital design layouts
- CO3: Apply digital techniques in fashion
- CO4: Develop technology-based visuals
- CO5: Demonstrate digital workflow understanding

Detailed Syllabus

Unit I: Digital design overview; role in fashion industry; raster, vector concepts; file formats; resolution; color modes; hardware requirements; digital workflow basics.

Unit II: Introduction to graphic software; interface familiarity; basic tools; drawing, selection; layers; transformations; workspace management; shortcuts usage.

Unit III: Digital color application; palettes; gradients; textures; pattern creation basics; repeat concepts; surface design introduction; accuracy and consistency.

Unit IV: Fashion application; digital flats; garment detailing; layout creation; mood boards; presentation boards; integration with manual sketches.

Unit V: Output and presentation; file preparation; printing basics; digital portfolios; professional standards; design documentation; ethical digital practices.

Text Books

1. Stewart, M. (2011). *LaunchPad for Design*. McGraw-Hill.
2. Shaughnessy, A. (2014). *How to Use Graphic Design*. Laurence King.
3. Dabner, D. (2017). *Graphic Design School*. Wiley.
4. Pemberton, L. (2013). *Digital Fashion Illustration*. Fairchild.
5. Clarke, S. (2012). *Digital Design Essentials*. AVA Publishing.

Reference Books

1. Samara, T. (2017). *Design Elements*. Rockport.
2. Heller, S. (2015). *Design Literacy*. Allworth.
3. Pipes, A. (2014). *Foundations of Art and Design*. Laurence King.
4. Lidwell, W. (2010). *Universal Principles of Design*. Rockport.
5. McWade, J. (2012). *Before and After Graphics*. Peachpit.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Design Thinking & Creative Processes

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand design thinking principles
2. Develop creative problem-solving skills
3. Apply structured ideation methods
4. Encourage innovation in fashion contexts
5. Strengthen analytical thinking

Course Outcomes

- CO1: Apply design thinking stages
- CO2: Generate creative solutions
- CO3: Analyze design problems
- CO4: Develop innovative concepts
- CO5: Demonstrate structured creativity

Detailed Syllabus

Unit I: Design thinking overview; human-centered design; problem identification; empathy mapping; observation techniques; relevance to fashion design challenges.

Unit II: Ideation methods; brainstorming; mind mapping; lateral thinking; creativity tools; divergent thinking; idea generation frameworks.

Unit III: Concept development; synthesis of ideas; refinement techniques; evaluation criteria; feasibility analysis; relevance to user needs.

Unit IV: Prototyping basics; mock-ups; visualization tools; feedback incorporation; iteration cycles; improvement strategies.

Unit V: Application in fashion; case examples; innovation in apparel; creative process documentation; reflective practice; professional relevance.

Text Books

1. Brown, T. (2009). *Change by Design*. Harper Business.

2. Ambrose, G., & Harris, P. (2010). *Design Thinking*. AVA Publishing.
3. Kelley, T. (2013). *Creative Confidence*. Crown Business.
4. Liedtka, J. (2018). *Design Thinking for the Greater Good*. Columbia.
5. Dorst, K. (2015). *Frame Innovation*. MIT Press.

Reference Books

1. Cross, N. (2011). *Design Thinking*. Berg.
2. Martin, R. (2009). *The Design of Business*. Harvard.
3. Michlewski, K. (2015). *Design Attitude*. Ashgate.
4. Stickdorn, M. (2018). *This Is Service Design Thinking*. BIS.
5. Kolko, J. (2015). *Well-Designed*. Harvard.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship / Industry Orientation

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Expose students to fashion industry environment
2. Understand professional work culture
3. Observe operational practices
4. Relate academic learning to industry
5. Develop professional discipline

Course Outcomes

- CO1: Identify industry operations
- CO2: Observe professional practices
- CO3: Relate theory to practice
- CO4: Demonstrate workplace etiquette
- CO5: Prepare industry exposure report

Guidelines

- Short-term industry attachment
- Observation-based learning
- Faculty monitoring and approval
- Maintenance of activity log
- Submission of internship report

Evaluation Scheme

Internal Evaluation (100%)

SEMESTER III

Pattern Making – I

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand fundamentals of pattern making
2. Learn body measurements and sizing systems
3. Develop basic block patterns
4. Apply pattern principles to garments
5. Build accuracy in pattern drafting

Course Outcomes

- CO1: Identify pattern making terminology
- CO2: Take and apply body measurements
- CO3: Draft basic garment blocks
- CO4: Analyze fit and balance
- CO5: Develop foundational patterns

Detailed Syllabus

Unit I: Introduction to pattern making; importance in garment production; pattern terminology; tools and equipment; body measurement techniques; standard sizing systems; size charts; measurement accuracy; relevance to garment fit and comfort.

Unit II: Basic pattern concepts; blocks, slopers; ease allowance types; functional, design ease; pattern symbols; grain lines; notches; balance marks; drafting principles; pattern accuracy and consistency.

Unit III: Drafting of basic bodice block; front, back; dart manipulation concepts; waist, bust darts; proportional relationships; fit considerations; block testing; correction basics.

Unit IV: Drafting of basic skirt block; straight skirt; measurement application; dart placement; waist shaping; hemline control; fit analysis; adaptation for different silhouettes.

Unit V: Introduction to basic sleeve block; armhole measurements; sleeve cap concepts; ease distribution; compatibility with bodice; basic collar introduction; neckline finishes; pattern set coordination.

Text Books

1. Aldrich, W. (2015). *Metric Pattern Cutting*. Wiley.
2. Armstrong, H. J. (2014). *Patternmaking for Fashion Design*. Pearson.
3. Cooklin, G. (2014). *Garment Technology for Fashion Designers*. Wiley.
4. Hollen, N., & Kundel, M. (2010). *Pattern Making by the Flat-Pattern Method*. Pearson.
5. Beazley, A., & Bond, T. (2012). *Pattern Cutting for Women's Tailored Jackets*. Wiley.

Reference Books

1. Joseph-Armstrong, H. (2018). *Patternmaking for Fashion Design*. Pearson.
2. Aldrich, W. (2011). *Metric Pattern Cutting for Women's Wear*. Wiley.
3. Shoben, M., & Ward, J. (2014). *Pattern Cutting and Making Up*. Routledge.
4. Cooklin, G. (2006). *Introduction to Clothing Manufacture*. Blackwell.
5. Haggar, A. (2016). *Creative Pattern Making*. Laurence King.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Garment Construction – II

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Advance garment construction skills
2. Learn complex sewing techniques
3. Construct structured garments
4. Apply quality finishing standards
5. Improve workmanship efficiency

Course Outcomes

- CO1: Apply advanced stitching techniques
- CO2: Construct complex garment components
- CO3: Demonstrate finishing accuracy
- CO4: Evaluate garment quality
- CO5: Integrate construction methods

Detailed Syllabus

Unit I: Review of construction basics; advanced machine operations; industrial sewing machines; stitch adjustments; seam performance; fabric behavior during stitching; safety practices; efficiency improvement techniques.

Unit II: Advanced seams and finishes; lapped seams; piped seams; bound finishes; bias finishes; decorative applications; functional suitability; fabric compatibility considerations.

Unit III: Sleeves construction; set-in sleeves; kimono, raglan sleeves; cuffs; plackets; collars construction; shirt collars; stand collars; accuracy and alignment control.

Unit IV: Garment components assembly; waistbands; yokes; pockets types; patch, welt, inseam; zipper applications; buttonholes; fastener quality evaluation.

Unit V: Construction of complete garments; dresses, shirts; assembly sequencing; pressing techniques; finishing standards; defect identification; quality assessment criteria.

Text Books

1. Cooklin, G. (2014). *Garment Technology for Fashion Designers*. Wiley.
2. Shaeffer, C. (2011). *Sewing for the Apparel Industry*. Fairchild.
3. Reader's Digest. (2011). *Complete Guide to Sewing*. Reader's Digest.
4. Marsh, J. (2016). *The Fashion Designer's Manual*. Wiley.
5. Aldrich, W. (2015). *Metric Pattern Cutting*. Wiley.

Reference Books

1. Anikweze, G. U. (2012). *Garment Construction*. Evans Brothers.
2. Fairhurst, C. (2013). *Textiles in Fashion*. Blackwell.
3. Hollen, N., & Kundel, M. (2010). *Pattern Making by the Flat-Pattern Method*. Pearson.
4. Cooklin, G. (2006). *Introduction to Clothing Manufacture*. Blackwell.
5. Shaeffer, C. (2013). *Couture Sewing Techniques*. Taunton.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Computer-Aided Fashion Design (CAD)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand CAD applications in fashion
2. Learn digital pattern and design tools
3. Apply CAD for garment visualization
4. Integrate digital workflows
5. Improve design accuracy

Course Outcomes

- CO1: Use fashion CAD tools
- CO2: Create digital garment components
- CO3: Apply CAD for pattern development
- CO4: Visualize designs digitally
- CO5: Demonstrate digital efficiency

Detailed Syllabus

Unit I: CAD overview in fashion; role in industry; software categories; hardware requirements; digital workflow; advantages over manual methods; accuracy and productivity considerations.

Unit II: Introduction to fashion CAD interfaces; basic commands; toolbars; navigation; digital drawing tools; file management; workspace customization.

Unit III: Digital pattern development basics; block digitization; pattern drafting tools; grading concepts introduction; measurement input; accuracy control.

Unit IV: Garment visualization; digital flats; detailing; color application; texture mapping; layout creation; coordination with pattern data.

Unit V: Output processes; plotters, printers; file export; digital documentation; data storage; ethical and professional CAD practices.

Text Books

1. Gerber Technology. (2015). *Introduction to CAD for Fashion*. Gerber.
2. Beazley, A., & Bond, T. (2012). *Computer-Aided Pattern Design*. Wiley.
3. Aldrich, W. (2015). *Metric Pattern Cutting*. Wiley.

4. Cooklin, G. (2014). *Garment Technology for Fashion Designers*. Wiley.
5. Pemberton, L. (2013). *Digital Fashion Illustration*. Fairchild.

Reference Books

1. McKelvey, K., & Munslow, J. (2012). *Fashion Design*. Wiley.
2. Shaughnessy, A. (2014). *How to Use Graphic Design*. Laurence King.
3. Dabner, D. (2017). *Graphic Design School*. Wiley.
4. Clarke, S. (2012). *Digital Design Essentials*. AVA.
5. Stewart, M. (2011). *LaunchPad for Design*. McGraw-Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Fashion Forecasting & Consumer Behaviour

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fashion forecasting principles
2. Analyze consumer behavior patterns
3. Study market trend dynamics
4. Apply forecasting to design planning
5. Develop market awareness

Course Outcomes

- CO1: Interpret fashion trends
- CO2: Analyze consumer preferences
- CO3: Apply forecasting methods
- CO4: Relate trends to market needs
- CO5: Develop informed design decisions

Detailed Syllabus

Unit I: Fashion forecasting overview; importance; short-term, long-term forecasting; fashion cycles; trend diffusion; forecasting agencies; industry relevance.

Unit II: Trend research sources; street style; runway analysis; trade fairs; media; cultural influences; lifestyle shifts; data interpretation methods.

Unit III: Consumer behavior fundamentals; consumer types; buying motives; psychological, social factors; perception; attitudes; fashion adoption patterns.

Unit IV: Market segmentation; demographic, psychographic segmentation; target customer profiling; lifestyle analysis; consumption trends; brand positioning.

Unit V: Application of forecasting; collection planning; range development; trend translation; commercial relevance; risk assessment; decision-making support.

Text Books

1. Brannon, E. L. (2010). *Fashion Forecasting*. Fairchild.
2. Solomon, M. (2014). *Consumer Behavior*. Pearson.
3. Easey, M. (2009). *Fashion Marketing*. Wiley.
4. Jackson, T. (2015). *Fashion Trends*. Laurence King.
5. Burns, L. D. (2011). *The Business of Fashion*. Fairchild.

Reference Books

1. Posner, H. (2015). *Marketing Fashion*. Laurence King.
2. Kotler, P. (2012). *Marketing Management*. Pearson.
3. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.
4. Tungate, M. (2012). *Fashion Brands*. Kogan Page.
5. Jackson, T. (2013). *Fashion Buying and Merchandising*. Palgrave.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Sustainable Fashion & Ethical Practices

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand sustainability concepts in fashion
2. Study ethical production practices
3. Analyze environmental impacts
4. Promote responsible design approaches
5. Develop sustainability awareness

Course Outcomes

- CO1: Explain sustainable fashion principles
- CO2: Identify ethical issues
- CO3: Analyze environmental impacts
- CO4: Apply sustainability concepts
- CO5: Promote responsible practices

Detailed Syllabus

Unit I: Sustainability overview; fashion industry impact; environmental challenges; resource consumption; pollution; social responsibility; need for sustainable practices.

Unit II: Ethical fashion concepts; labor practices; fair trade; worker welfare; transparency; supply chain ethics; compliance standards.

Unit III: Sustainable materials; organic fibres; recycled textiles; eco-friendly fabrics; material selection criteria; performance considerations.

Unit IV: Sustainable production methods; waste reduction; zero-waste design; recycling; upcycling; life cycle assessment basics.

Unit V: Consumer role; sustainable consumption; slow fashion; awareness building; certifications; future directions in ethical fashion.

Text Books

1. Fletcher, K. (2014). *Sustainable Fashion and Textiles*. Earthscan.
2. Gwilt, A. (2014). *A Practical Guide to Sustainable Fashion*. Bloomsbury.
3. Black, S. (2012). *The Sustainable Fashion Handbook*. Thames & Hudson.
4. Henninger, C. E. (2016). *Sustainability in Fashion*. Springer.

5. Hethorn, J., & Ulasewicz, C. (2015). *Sustainable Fashion*. Fairchild.

Reference Books

1. Thomas, S. (2018). *Fashion Ethics*. Bloomsbury.
2. Niinimäki, K. (2018). *Sustainable Fashion in a Circular Economy*. Aalto.
3. Siegle, L. (2011). *To Die For*. Fourth Estate.
4. Beard, N. (2013). *The Sustainable Fashion Handbook*. Thames & Hudson.
5. Joy, A. (2012). *Fast Fashion, Sustainability, and the Ethical Appeal*. Journal Compilation.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Humanities Elective (Cultural Studies / Aesthetics)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand cultural and aesthetic concepts
2. Relate culture to fashion expression
3. Analyze visual aesthetics
4. Enhance critical appreciation
5. Broaden interdisciplinary perspective

Course Outcomes

- CO1: Interpret cultural influences
- CO2: Analyze aesthetic principles
- CO3: Relate culture and fashion
- CO4: Apply aesthetic judgment
- CO5: Develop critical thinking

Detailed Syllabus

Unit I: Culture concepts; definitions; cultural identity; traditions; symbols; relevance to dress and fashion expression.

Unit II: Aesthetics fundamentals; beauty concepts; form appreciation; sensory perception; visual culture; design relevance.

Unit III: Art and fashion relationship; historical art movements; influence on fashion aesthetics; cross-disciplinary connections.

Unit IV: Contemporary cultural trends; globalization; media influence; cultural exchange; impact on fashion design.

Unit V: Application in fashion; cultural sensitivity; aesthetic evaluation; design inspiration; contextual relevance.

Text Books

1. Barnard, M. (2014). *Fashion as Communication*. Routledge.
2. Soper, K. (2012). *The Aesthetics of Design*. Sage.
3. Steele, V. (2015). *Fashion and Culture*. Yale.
4. Geczy, A., & Karaminas, V. (2012). *Fashion and Art*. Berg.
5. Scruton, R. (2011). *Beauty*. Oxford.

Reference Books

1. Entwistle, J. (2015). *The Fashioned Body*. Polity.
2. Crane, D. (2012). *Fashion and Its Social Agendas*. University of Chicago Press.
3. Kawamura, Y. (2018). *Fashion-ology*. Berg.
4. Storey, J. (2015). *Cultural Theory and Popular Culture*. Routledge.
5. Barthes, R. (2013). *The Fashion System*. Bloomsbury.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Gain hands-on industry exposure
2. Observe professional fashion practices
3. Apply academic learning in workplace
4. Develop professional discipline

5. Prepare industry-oriented documentation

Course Outcomes

- CO1: Identify workplace practices
- CO2: Demonstrate professional conduct
- CO3: Relate theory to practice
- CO4: Maintain internship records
- CO5: Submit comprehensive report

Guidelines

- Industry placement under approved organization
- Maintenance of daily activity log
- Faculty supervision and evaluation
- Submission of internship report
- Oral presentation if required

Evaluation Scheme

Internal Evaluation (100%)

SEMESTER IV

Pattern Making – II

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced pattern making skills
2. Apply pattern adaptation techniques
3. Understand garment variation development
4. Improve fit accuracy and balance
5. Integrate creativity with technical precision

Course Outcomes

- CO1: Draft advanced garment patterns
- CO2: Apply pattern modifications accurately
- CO3: Analyze fit and silhouette variations
- CO4: Develop style-based patterns
- CO5: Produce production-ready patterns

Detailed Syllabus

Unit I: Review of basic blocks; bodice, skirt, sleeve; pattern corrections; balance refinement; fit evaluation; pattern terminology reinforcement; preparation for advanced adaptations; accuracy, consistency, professional drafting practices.

Unit II: Dart manipulation techniques; slash and spread; pivot methods; style line development; princess seams; yokes; gathers, pleats; conversion of basic blocks into design patterns.

Unit III: Drafting of trousers; body measurements; trouser block development; waist shaping; leg variations; fit issues; balance control; adaptation for different silhouettes and apparel categories.

Unit IV: Pattern development for dresses; one-piece garments; style variations; panel manipulation; flare control; neckline, sleeve integration; design interpretation accuracy; pattern coordination.

Unit V: Introduction to pattern grading; size range concepts; grading rules; manual grading basics; size increments; production relevance; quality control; documentation standards for industry application.

Text Books

1. Aldrich, W. (2015). *Metric Pattern Cutting*. Wiley.
2. Armstrong, H. J. (2014). *Patternmaking for Fashion Design*. Pearson.
3. Beazley, A., & Bond, T. (2012). *Pattern Cutting for Women's Wear*. Wiley.
4. Cooklin, G. (2014). *Garment Technology for Fashion Designers*. Wiley.
5. Haggar, A. (2016). *Creative Pattern Making*. Laurence King.

Reference Books

1. Shoben, M., & Ward, J. (2014). *Pattern Cutting and Making Up*. Routledge.
2. Aldrich, W. (2011). *Metric Pattern Cutting for Women's Wear*. Wiley.
3. Hollen, N., & Kundel, M. (2010). *Pattern Making by the Flat-Pattern Method*. Pearson.
4. Joseph-Armstrong, H. (2018). *Patternmaking for Fashion Design*. Pearson.
5. Cooklin, G. (2006). *Introduction to Clothing Manufacture*. Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Textile Design & Surface Ornamentation

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand digital textile design concepts
2. Learn surface ornamentation techniques
3. Apply digital tools for textile patterns
4. Develop creative surface designs
5. Integrate aesthetics with technology

Course Outcomes

- CO1: Create digital textile patterns
- CO2: Apply ornamentation techniques
- CO3: Use digital tools effectively
- CO4: Develop repeat designs

- CO5: Produce surface design concepts

Detailed Syllabus

Unit I: Introduction to textile surface design; role in fashion; digital versus manual methods; design elements in textiles; repeat concepts; placement considerations; relevance to apparel and interiors.

Unit II: Digital tools for textile design; software interfaces; brushes, motifs; layers; color application; resolution control; workflow for textile pattern development.

Unit III: Repeat pattern techniques; block, half-drop, mirror repeats; motif scaling; alignment accuracy; seamless pattern creation; technical precision in repeats.

Unit IV: Surface ornamentation basics; embroidery concepts; prints, textures; embellishment styles; traditional and contemporary references; aesthetic and functional considerations.

Unit V: Application in fashion products; fabric suitability; design placement on garments; coordination with silhouettes; documentation; presentation of digital textile collections.

Text Books

1. Udale, J. (2014). *Textiles and Fashion*. Bloomsbury.
2. Clarke, S. (2012). *Textile Design*. Laurence King.
3. Pemberton, L. (2013). *Digital Fashion Illustration*. Fairchild.
4. Briggs-Goode, A. (2013). *Textile Design*. AVA Publishing.
5. Wilson, J. (2016). *Surface Pattern Design*. Bloomsbury.

Reference Books

1. Seivewright, S. (2012). *Basics Fashion Design: Textiles and Fashion*. AVA.
2. Dormer, P. (2014). *The Culture of Craft*. Manchester University Press.
3. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.
4. McKelvey, K., & Munslow, J. (2012). *Fashion Design*. Wiley.
5. Pipes, A. (2014). *Foundations of Art and Design*. Laurence King.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Fashion Photography & Visual Merchandising

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fashion photography fundamentals
2. Learn visual merchandising principles
3. Apply visual storytelling techniques
4. Develop aesthetic presentation skills
5. Integrate branding and visuals

Course Outcomes

- CO1: Apply basic fashion photography techniques
- CO2: Create visual merchandising concepts
- CO3: Analyze visual presentation strategies
- CO4: Develop coordinated visual displays
- CO5: Demonstrate brand-oriented visuals

Detailed Syllabus

Unit I: Introduction to fashion photography; camera basics; lighting fundamentals; composition rules; styling coordination; visual aesthetics; relevance to fashion communication.

Unit II: Fashion shoot planning; concepts; mood boards; model coordination; location, studio shoots; styling elements; shot sequencing; workflow organization.

Unit III: Post-production basics; image selection; color correction; cropping; layout preparation; ethical editing practices; presentation standards.

Unit IV: Visual merchandising fundamentals; retail display principles; window displays; store layouts; color coordination; lighting impact; consumer attention strategies.

Unit V: Integration of photography and merchandising; brand identity; visual storytelling; seasonal displays; digital platforms; evaluation of visual effectiveness.

Text Books

1. Seivewright, S. (2013). *Fashion Marketing*. AVA Publishing.
2. Tungate, M. (2012). *Fashion Brands*. Kogan Page.
3. Hines, T., & Bruce, M. (2012). *Fashion Marketing*. Routledge.

4. Posner, H. (2015). *Marketing Fashion*. Laurence King.
5. Diamond, J. (2014). *Fashion Retailing*. Pearson.

Reference Books

1. Davis, F. (2010). *Fashion, Culture, and Identity*. University of Chicago Press.
2. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.
3. Solomon, M. (2014). *Consumer Behavior*. Pearson.
4. Easey, M. (2009). *Fashion Marketing*. Wiley.
5. Jackson, T. (2015). *Fashion Trends*. Laurence King.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Apparel Production & Quality Management

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand apparel production systems
2. Learn quality management principles
3. Analyze manufacturing workflows
4. Apply quality control methods
5. Develop production awareness

Course Outcomes

- CO1: Identify apparel production processes
- CO2: Analyze production layouts
- CO3: Apply quality control concepts
- CO4: Evaluate manufacturing efficiency
- CO5: Demonstrate production planning understanding

Detailed Syllabus

Unit I: Apparel production overview; manufacturing flow; mass production concepts; batch, modular systems; workflow organization; roles and responsibilities in production units.

Unit II: Production planning basics; order processing; scheduling; capacity planning; line balancing; productivity measures; efficiency improvement concepts.

Unit III: Quality management fundamentals; quality concepts; inspection stages; fabric inspection; in-process, final inspection; defect classification; quality standards.

Unit IV: Quality control tools; sampling methods; AQL basics; measurement systems; documentation; reporting; corrective actions.

Unit V: Industrial practices; compliance requirements; safety standards; cost control; production challenges; continuous improvement; relevance to fashion industry competitiveness.

Text Books

1. Glock, R. E., & Kunz, G. I. (2004). *Apparel Manufacturing*. Pearson.
2. Cooklin, G. (2014). *Garment Technology for Fashion Designers*. Wiley.
3. Fairhurst, C. (2013). *Textiles in Fashion*. Blackwell.
4. Tyler, D. (2008). *Carr and Latham's Technology of Clothing Manufacture*. Wiley.
5. Shaeffer, C. (2011). *Sewing for the Apparel Industry*. Fairchild.

Reference Books

1. Juran, J. M. (2010). *Quality Handbook*. McGraw-Hill.
2. Crosby, P. (2013). *Quality Is Free*. McGraw-Hill.
3. Bheda, R. (2014). *Managing Quality in Apparel Industry*. McGraw-Hill.
4. Glock, R. E. (2016). *Quality Management in Apparel*. Pearson.
5. Cooklin, G. (2006). *Introduction to Clothing Manufacture*. Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (Accessory Design / Fashion Styling)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand accessory or styling concepts
2. Develop complementary design skills
3. Apply aesthetics in fashion coordination

4. Enhance creative versatility
5. Support fashion product presentation

Course Outcomes

- CO1: Identify accessory or styling elements
- CO2: Apply coordination principles
- CO3: Develop styling concepts
- CO4: Enhance fashion aesthetics
- CO5: Demonstrate creative application

Detailed Syllabus

Unit I: Introduction to accessories or styling; scope; role in fashion; categories; functional and aesthetic relevance; fashion coordination basics.

Unit II: Materials and forms; metals, textiles; trims; finishes; structural considerations; comfort and usability aspects.

Unit III: Design and styling principles; proportion; balance; harmony; coordination with garments; visual impact.

Unit IV: Trend influence; cultural references; contemporary styles; seasonal relevance; market preferences.

Unit V: Application and presentation; styling for occasions; accessory integration; portfolio basics; professional relevance.

Text Books

1. McKelvey, K., & Munslow, J. (2012). *Fashion Design*. Wiley.
2. Stone, E. (2014). *Accessory Design*. Fairchild.
3. Posner, H. (2015). *Marketing Fashion*. Laurence King.
4. Jackson, T. (2015). *Fashion Trends*. Laurence King.
5. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.

Reference Books

1. Davis, F. (2010). *Fashion, Culture, and Identity*. University of Chicago Press.
2. Steele, V. (2015). *Fashion and Culture*. Yale.
3. Crane, D. (2012). *Fashion and Its Social Agendas*. University of Chicago Press.
4. Entwistle, J. (2015). *The Fashioned Body*. Polity.
5. Barnard, M. (2014). *Fashion as Communication*. Routledge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Fashion Studio

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Apply digital tools in studio practice
2. Integrate design and technology
3. Develop digital fashion concepts
4. Enhance creative execution
5. Build professional studio discipline

Course Outcomes

- CO1: Apply digital techniques creatively
- CO2: Develop digital fashion concepts
- CO3: Integrate design workflows
- CO4: Produce studio outputs
- CO5: Present digital design work

List of Experiments / Exercises *(11 Exercises)*

1. Digital mood board creation using visual references, color palettes, and concept articulation aligned with fashion themes.
2. Development of digital fashion illustrations integrating manual sketches with software-based rendering techniques.
3. Creation of digital garment flats emphasizing technical accuracy, proportions, and detailing clarity.
4. Digital textile or surface pattern application on garment visuals using appropriate software tools.
5. Experimentation with color variations and fabric simulations for selected garment designs.
6. Compilation of coordinated digital design sheets for a mini fashion concept.

7. Digital layout preparation for fashion presentation boards with typography and visual hierarchy.
8. Workflow integration exercise combining illustration, pattern visualization, and surface design digitally.
9. Exploration of digital trend references and translation into design visuals.
10. Portfolio-oriented digital documentation of studio outputs with annotations.
11. Final digital studio presentation demonstrating concept development, execution quality, and professional communication.

Expected Outcomes

Digital design integration; creative execution; improved visualization skills; professional studio presentation competence.

Evaluation Scheme

Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Continue industry exposure
2. Strengthen professional skills
3. Observe advanced operational practices
4. Apply academic learning practically
5. Prepare detailed industry documentation

Course Outcomes

- CO1: Demonstrate workplace competence
- CO2: Apply professional ethics
- CO3: Relate advanced theory to practice
- CO4: Maintain detailed internship records
- CO5: Submit evaluative internship report

Guidelines

- Approved industry placement

- Faculty supervision
- Maintenance of detailed activity log
- Submission of internship report
- Evaluation through internal assessment

Evaluation Scheme

Internal Evaluation (100%)

SEMESTER V

3D Fashion Design & Virtual Prototyping

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand 3D fashion design concepts
2. Apply virtual prototyping tools
3. Develop digital garment simulations
4. Integrate fit analysis in virtual environments
5. Enhance efficiency in design visualization

Course Outcomes

- CO1: Explain principles of 3D fashion design
- CO2: Create virtual garment prototypes
- CO3: Apply fit and drape simulations
- CO4: Integrate 3D tools in design workflow
- CO5: Evaluate virtual prototypes critically

Detailed Syllabus

Unit I: Introduction to 3D fashion design; evolution of digital prototyping; advantages over physical sampling; industry applications; software ecosystem overview; virtual workflow stages; accuracy, speed, sustainability considerations in digital garment development.

Unit II: Avatar creation fundamentals; body measurement input; sizing systems; posture adjustment; customization options; relevance to fit accuracy; relationship between avatar parameters and garment simulation outcomes.

Unit III: 3D garment construction basics; pattern import; stitching simulation; seam settings; fabric assignment; particle distance control; visualization of garment assembly in virtual environments.

Unit IV: Fabric simulation and drape analysis; physical fabric parameters; weight, stretch, stiffness; collision detection; gravity effects; fit tension maps; evaluation of comfort and silhouette accuracy.

Unit V: Virtual prototyping applications; design iteration; colorways; style variations; presentation rendering; communication with production teams; role in sustainable design practices and cost reduction.

Text Books

1. Kim, S., & Johnson, K. K. P. (2019). *3D Virtual Clothing*. Springer.
2. McCartney, A. (2018). *Digital Fashion Innovation*. Bloomsbury.
3. Ashdown, S. P. (2011). *Sizing in Clothing*. Woodhead.
4. Beazley, A., & Bond, T. (2012). *Computer-Aided Pattern Design*. Wiley.
5. Pemberton, L. (2013). *Digital Fashion Illustration*. Fairchild.

Reference Books

1. Townsend, K. (2020). *Digital Textile and Apparel Technologies*. Woodhead.
2. Nayak, R., & Padhye, R. (2017). *Automation in Garment Manufacturing*. Woodhead.
3. Aldrich, W. (2015). *Metric Pattern Cutting*. Wiley.
4. Clarke, S. (2012). *Digital Design Essentials*. AVA Publishing.
5. Fletcher, K. (2014). *Sustainable Fashion and Textiles*. Earthscan.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Fashion Technology & Smart Wearables

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fashion technology integration
2. Study smart textile concepts
3. Analyze wearable technology applications
4. Explore functional apparel innovations
5. Develop interdisciplinary awareness

Course Outcomes

- CO1: Identify smart wearable components
- CO2: Explain functional textile technologies
- CO3: Analyze applications of wearables
- CO4: Integrate technology with apparel concepts

- CO5: Evaluate future fashion technology trends

Detailed Syllabus

Unit I: Fashion technology overview; convergence of apparel and electronics; evolution of smart wearables; application domains; healthcare, sports, lifestyle; opportunities and challenges.

Unit II: Smart textiles fundamentals; conductive fibres; sensors; actuators; energy harvesting; integration techniques; performance and comfort considerations.

Unit III: Wearable electronics; components; microcontrollers; power sources; data transmission; safety; durability; design constraints in apparel integration.

Unit IV: Functional apparel design; user-centered approach; ergonomics; performance garments; protective clothing; interaction between technology and garment construction.

Unit V: Emerging trends; innovation pathways; ethical considerations; sustainability issues; future prospects of fashion technology and smart wearable markets.

Text Books

1. Tao, X. (2015). *Handbook of Smart Textiles*. Springer.
2. McCann, J., & Bryson, D. (2009). *Smart Clothes and Wearable Technology*. Woodhead.
3. Quinn, B. (2013). *Textiles Futures*. Berg.
4. Ashdown, S. P. (2011). *Sizing in Clothing*. Woodhead.
5. Nayak, R., & Padhye, R. (2017). *Automation in Garment Manufacturing*. Woodhead.

Reference Books

1. Seymour, S. (2008). *Fashionable Technology*. Springer.
2. Stoppa, M., & Chiolerio, A. (2014). *Wearable Electronics*. Sensors Journal.
3. Braddock Clarke, S. (2005). *Techno Textiles*. Thames & Hudson.
4. Townsend, K. (2020). *Digital Textile and Apparel Technologies*. Woodhead.
5. Fletcher, K. (2014). *Sustainable Fashion and Textiles*. Earthscan.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Branding, Marketing & Fashion Entrepreneurship

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fashion branding fundamentals
2. Analyze marketing strategies in fashion
3. Study entrepreneurship concepts
4. Develop business-oriented thinking
5. Encourage innovation and enterprise creation

Course Outcomes

- CO1: Explain branding concepts in fashion
- CO2: Apply marketing strategies
- CO3: Analyze fashion business models
- CO4: Develop entrepreneurial ideas
- CO5: Evaluate market viability

Detailed Syllabus

Unit I: Branding fundamentals; brand identity; brand image; positioning; brand equity; relevance in fashion industry; differentiation strategies; consumer perception.

Unit II: Fashion marketing concepts; marketing mix; product, price, place, promotion; communication channels; digital marketing basics; retail and online platforms.

Unit III: Consumer engagement strategies; storytelling; influencer marketing; visual merchandising role; customer relationship management; loyalty building approaches.

Unit IV: Fashion entrepreneurship basics; startup ecosystem; opportunity identification; business models; funding sources; risk assessment; legal considerations overview.

Unit V: Business planning; fashion venture planning; cost structures; pricing strategies; scalability; sustainability integration; evaluation of entrepreneurial success factors.

Text Books

1. Posner, H. (2015). *Marketing Fashion*. Laurence King.
2. Easey, M. (2009). *Fashion Marketing*. Wiley.
3. Tungate, M. (2012). *Fashion Brands*. Kogan Page.
4. Burns, L. D. (2011). *The Business of Fashion*. Fairchild.

5. Kotler, P. (2012). *Marketing Management*. Pearson.

Reference Books

1. Jackson, T. (2015). *Fashion Buying and Merchandising*. Palgrave.
2. Solomon, M. (2014). *Consumer Behavior*. Pearson.
3. Moore, C. (2010). *Fashion Branding and Consumer Behaviours*. Fairchild.
4. Bjerke, B. (2013). *Entrepreneurship and Culture*. Edward Elgar.
5. Ries, E. (2011). *The Lean Startup*. Crown Business.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Fashion Illustration & Animation

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Apply advanced digital illustration tools
2. Understand animation principles for fashion
3. Create motion-based fashion visuals
4. Integrate storytelling with digital media
5. Enhance portfolio-oriented outputs

Course Outcomes

- CO1: Create digital fashion illustrations
- CO2: Apply basic animation techniques
- CO3: Develop animated fashion visuals
- CO4: Integrate narrative elements
- CO5: Produce professional digital outputs

Detailed Syllabus

Unit I: Digital illustration advancement; software tools; brushes; layers; textures; lighting effects; refinement of fashion visuals for professional outputs.

Unit II: Principles of animation; frame concepts; timing; movement; squash, stretch basics; relevance to fashion visualization.

Unit III: Fashion animation techniques; garment movement; walk cycles; fabric flow; motion representation; silhouette continuity.

Unit IV: Storyboarding for fashion; concept sequencing; visual narratives; mood continuity; integration of illustration and animation elements.

Unit V: Presentation and portfolio development; digital formats; animation rendering; export settings; online platforms; professional presentation standards.

Text Books

1. Pemberton, L. (2013). *Digital Fashion Illustration*. Fairchild.
2. Wells, P. (2013). *Understanding Animation*. Routledge.
3. White, T. (2012). *Animation from Pencils to Pixels*. Focal Press.
4. McKelvey, K., & Munslow, J. (2012). *Fashion Design*. Wiley.
5. Clarke, S. (2012). *Digital Design Essentials*. AVA.

Reference Books

1. Hogben, L. (2015). *Fashion Design Drawing Course*. Barron's.
2. Sorger, R., & Udale, J. (2017). *The Fundamentals of Fashion Design*. Bloomsbury.
3. Manovich, L. (2013). *Software Takes Command*. Bloomsbury.
4. Samara, T. (2017). *Design Elements*. Rockport.
5. Heller, S. (2015). *Design Literacy*. Allworth.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Luxury Fashion / Sustainable Apparel Design)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand specialized fashion segments
2. Analyze luxury or sustainable apparel concepts
3. Apply advanced design perspectives
4. Develop niche market awareness
5. Enhance professional specialization

Course Outcomes

- CO1: Identify characteristics of chosen specialization
- CO2: Apply advanced design approaches
- CO3: Analyze market expectations
- CO4: Develop specialized design concepts
- CO5: Evaluate professional practices

Detailed Syllabus

Unit I: Overview of luxury or sustainable fashion; market scope; consumer profiles; value systems; differentiation factors; global and Indian perspectives.

Unit II: Materials and craftsmanship; premium textiles; sustainable materials; sourcing ethics; quality benchmarks; performance considerations.

Unit III: Design development; exclusivity; storytelling; innovation; brand alignment; aesthetic refinement; functionality balance.

Unit IV: Production and supply chain; limited editions; sustainable processes; quality assurance; certification standards; transparency requirements.

Unit V: Market positioning; pricing strategies; communication; retail formats; future growth opportunities; professional career pathways.

Text Books

1. Kapferer, J. N. (2012). *The Luxury Strategy*. Kogan Page.
2. Fletcher, K. (2014). *Sustainable Fashion and Textiles*. Earthscan.
3. Jackson, T. (2015). *Fashion Trends*. Laurence King.
4. Tungate, M. (2012). *Fashion Brands*. Kogan Page.
5. Black, S. (2012). *The Sustainable Fashion Handbook*. Thames & Hudson.

Reference Books

1. Thomas, S. (2018). *Fashion Ethics*. Bloomsbury.
2. Moore, C. (2010). *Fashion Branding and Consumer Behaviours*. Fairchild.
3. Joy, A. (2012). *Fast Fashion, Sustainability, and the Ethical Appeal*. Journal Compilation.
4. Niinimäki, K. (2018). *Sustainable Fashion in a Circular Economy*. Aalto.
5. Okonkwo, U. (2007). *Luxury Fashion Branding*. Palgrave.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project (Digital Fashion Collection)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Apply cumulative fashion knowledge
2. Develop a digital fashion collection
3. Integrate design, technology, and research
4. Enhance independent project execution
5. Prepare professional project documentation

Course Outcomes

- CO1: Conceptualize a digital fashion collection
- CO2: Apply digital tools effectively
- CO3: Demonstrate design coherence
- CO4: Document project processes
- CO5: Present project outcomes professionally

Guidelines

- Individual or small group project
- Theme-based digital fashion collection
- Integration of 3D, digital illustration, or CAD tools
- Periodic reviews by faculty panel
- Submission of project report and presentation

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER VI

Fashion E-Commerce & Digital Retailing

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fashion e-commerce ecosystem
2. Analyze digital retail business models
3. Study online consumer behavior
4. Apply digital strategies for fashion retail
5. Develop awareness of omni-channel retailing

Course Outcomes

- CO1: Explain fashion e-commerce frameworks
- CO2: Analyze digital retail platforms
- CO3: Interpret online consumer behavior
- CO4: Apply e-commerce strategies in fashion
- CO5: Evaluate digital retail performance

Detailed Syllabus

Unit I: Fashion e-commerce overview; evolution of digital retailing; online fashion business models; B2B, B2C, D2C formats; global and Indian market landscape; opportunities, challenges; technology-driven transformation in fashion retail.

Unit II: Digital retail platforms; website architecture; mobile commerce; user interface basics; customer journey mapping; usability principles; visual merchandising in digital environments; content management fundamentals.

Unit III: Online consumer behavior; purchase decision process; trust factors; reviews, ratings; personalization concepts; data-driven insights; role of social media in influencing fashion buying behavior.

Unit IV: Digital marketing for fashion retail; SEO basics; social media marketing; influencer collaborations; email marketing; paid advertising; analytics introduction; performance measurement metrics.

Unit V: Logistics and operations; inventory management; order fulfillment; returns management; payment systems; cybersecurity basics; legal considerations; future trends in fashion e-commerce and digital retailing.

Text Books

1. Posner, H. (2015). *Marketing Fashion*. Laurence King.
2. Easey, M. (2009). *Fashion Marketing*. Wiley.
3. Chaffey, D. (2015). *Digital Business and E-Commerce Management*. Pearson.
4. Jackson, T. (2015). *Fashion Buying and Merchandising*. Palgrave.
5. Solomon, M. (2014). *Consumer Behavior*. Pearson.

Reference Books

1. Tungate, M. (2012). *Fashion Brands*. Kogan Page.
2. Kotler, P. (2012). *Marketing Management*. Pearson.
3. Ryan, D. (2016). *Understanding Digital Marketing*. Kogan Page.
4. Turban, E. (2015). *Electronic Commerce*. Springer.
5. Strauss, J. (2014). *E-Marketing*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Fashion Law, Intellectual Property & Ethics

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand legal framework in fashion industry
2. Study intellectual property rights
3. Analyze ethical issues in fashion
4. Apply legal awareness to professional practice
5. Promote responsible industry conduct

Course Outcomes

- CO1: Identify fashion-related legal issues
- CO2: Explain intellectual property concepts
- CO3: Analyze ethical challenges
- CO4: Apply legal principles in fashion contexts

- CO5: Demonstrate professional responsibility

Detailed Syllabus

Unit I: Fashion law overview; legal environment; contracts basics; designer agreements; manufacturing contracts; licensing concepts; relevance of law in fashion business operations.

Unit II: Intellectual property fundamentals; copyright; trademarks; design protection; patents overview; infringement issues; protection of creative works in fashion industry.

Unit III: Fashion ethics; labor laws; worker rights; fair trade; sustainability compliance; corporate social responsibility; transparency and accountability in supply chains.

Unit IV: Consumer protection laws; labeling regulations; advertising standards; product liability; e-commerce regulations; compliance requirements for fashion businesses.

Unit V: Global perspectives; international trade laws; import-export regulations; dispute resolution; ethical decision-making frameworks; future challenges in fashion law and ethics.

Text Books

1. Hemphill, C. S., & Suk, J. (2017). *Fashion Law*. Oxford University Press.
2. Bainbridge, D. (2012). *Intellectual Property*. Pearson.
3. McDonagh, L. (2016). *Fashion Law and Intellectual Property*. Edward Elgar.
4. Thomas, S. (2018). *Fashion Ethics*. Bloomsbury.
5. Fisher, W. (2014). *Intellectual Property and Innovation*. Harvard.

Reference Books

1. WIPO. (2016). *Intellectual Property Handbook*. WIPO.
2. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.
3. Joy, A. (2012). *Fast Fashion, Sustainability, and the Ethical Appeal*. Journal Compilation.
4. Kotler, P. (2012). *Marketing Management*. Pearson.
5. Crane, D. (2012). *Fashion and Its Social Agendas*. University of Chicago Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Emerging Trends in Digital Fashion

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand emerging digital fashion trends
2. Analyze technological innovations
3. Study future-oriented fashion practices
4. Evaluate impact of digital disruption
5. Develop adaptability to industry evolution

Course Outcomes

- CO1: Identify emerging digital fashion trends
- CO2: Analyze technological influences
- CO3: Interpret future fashion scenarios
- CO4: Apply trend insights strategically
- CO5: Demonstrate forward-looking awareness

Detailed Syllabus

Unit I: Digital fashion evolution; convergence of technology and design; virtual fashion concepts; digital garments; industry transformation drivers; relevance to contemporary fashion practice.

Unit II: Metaverse and fashion; virtual environments; digital avatars; NFT fashion concepts; blockchain basics; opportunities and challenges for designers and brands.

Unit III: Artificial intelligence in fashion; design automation; recommendation systems; trend analytics; personalization technologies; ethical considerations in AI-driven fashion systems.

Unit IV: Extended reality applications; AR, VR in fashion retail; virtual try-ons; immersive experiences; consumer engagement; design visualization advancements.

Unit V: Future outlook; sustainability and technology integration; circular digital fashion; skill requirements; career pathways; strategic preparedness for evolving digital fashion industry.

Text Books

1. McCartney, A. (2018). *Digital Fashion Innovation*. Bloomsbury.
2. Townsend, K. (2020). *Digital Textile and Apparel Technologies*. Woodhead.
3. Quinn, B. (2013). *Textiles Futures*. Berg.

4. Tungate, M. (2012). *Fashion Brands*. Kogan Page.
5. Fletcher, K. (2014). *Sustainable Fashion and Textiles*. Earthscan.

Reference Books

1. Seymour, S. (2008). *Fashionable Technology*. Springer.
2. Manovich, L. (2013). *Software Takes Command*. Bloomsbury.
3. Stoppa, M., & Chiolerio, A. (2014). *Wearable Electronics*. Sensors Journal.
4. Niinimäki, K. (2018). *Sustainable Fashion in a Circular Economy*. Aalto.
5. Jackson, T. (2015). *Fashion Trends*. Laurence King.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (Costume Design / Fashion Communication)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand elective specialization concepts
2. Develop interdisciplinary fashion skills
3. Apply communication or costume principles
4. Enhance creative adaptability
5. Support professional diversification

Course Outcomes

- CO1: Identify elective-specific concepts
- CO2: Apply creative techniques
- CO3: Analyze contextual fashion requirements
- CO4: Develop specialized outputs
- CO5: Demonstrate professional versatility

Detailed Syllabus

Unit I: Introduction to costume design or fashion communication; scope; applications; relevance across media, performance, branding, and fashion industries.

Unit II: Concept development; narrative understanding; character analysis or message framing; visual interpretation; research and reference integration.

Unit III: Design or communication techniques; material selection; styling; layout planning; visual storytelling; coherence and clarity.

Unit IV: Industry practices; media platforms; performance requirements; branding contexts; collaboration with creative teams.

Unit V: Application and presentation; portfolio development; professional documentation; evaluation of effectiveness; career opportunities in elective domain.

Text Books

1. McKelvey, K., & Munslow, J. (2012). *Fashion Design*. Wiley.
2. Barnard, M. (2014). *Fashion as Communication*. Routledge.
3. Peacock, J. (2013). *Fashion Sourcebooks*. Thames & Hudson.
4. Jackson, T. (2015). *Fashion Trends*. Laurence King.
5. Calasibetta, C. M. (2011). *Fairchild Dictionary of Fashion*. Fairchild.

Reference Books

1. Entwistle, J. (2015). *The Fashioned Body*. Polity.
2. Crane, D. (2012). *Fashion and Its Social Agendas*. University of Chicago Press.
3. Davis, F. (2010). *Fashion, Culture, and Identity*. University of Chicago Press.
4. Steele, V. (2015). *Fashion and Culture*. Yale.
5. Storey, J. (2015). *Cultural Theory and Popular Culture*. Routledge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project (Industry / Portfolio Based)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Integrate complete fashion design knowledge
2. Execute industry or portfolio-based project
3. Demonstrate independent professional capability
4. Apply research, design, and technology cohesively

5. Prepare for professional transition

Course Outcomes

- CO1: Conceptualize comprehensive fashion project
- CO2: Apply advanced digital and design skills
- CO3: Demonstrate professional project execution
- CO4: Document processes systematically
- CO5: Present industry-ready outcomes

Guidelines

- Individual major project
- Industry-linked or portfolio-oriented theme
- Periodic reviews by internal and external experts
- Submission of project report and design outputs
- Final presentation and evaluation

Evaluation Scheme

Continuous Assessment (100%)

Seminar / Viva-Voce

Course Category: Seminar / Viva-Voce Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop research presentation skills
2. Strengthen subject articulation ability
3. Evaluate comprehensive program learning
4. Prepare for professional interviews
5. Demonstrate academic maturity

Course Outcomes

- CO1: Present seminar topic effectively
- CO2: Demonstrate conceptual clarity
- CO3: Respond to technical queries

- CO4: Integrate interdisciplinary knowledge
- CO5: Exhibit professional communication skills

Guidelines

- Seminar on emerging fashion or digital topic
- Structured presentation and documentation
- Viva-voce examination by internal panel
- Assessment of knowledge depth and articulation

Evaluation Scheme

Internal Evaluation (100%)

Integrated Programme in Interior Designing & Smart Systems

Duration: 4 Years | 8 SEMESTER s | Total Credits: 160

SEMESTER I

Fundamentals of Interior Design

Course Category: Design Foundations & Theory
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To establish foundational understanding of interior design discipline, scope, and professional context.
2. To develop awareness of interior spaces, functions, and user requirements.
3. To familiarize students with basic interior design processes and terminology.
4. To introduce spatial elements, forms, and interior components.
5. To align design thinking with built environment fundamentals.

Course Outcomes

- CO1: Understand interior design as a professional and multidisciplinary field.
- CO2: Identify functional requirements of interior spaces.
- CO3: Apply basic design vocabulary and concepts to interior contexts.
- CO4: Analyze relationships between space, form, and function.
- CO5: Interpret interior design processes at a fundamental level.

Detailed Syllabus

Unit I
Interior design definition, scope, evolution; role of interior designer; relationship with architecture; residential, commercial, institutional interiors; interdisciplinary linkages; professional ethics, responsibilities; overview of design process stages; client interaction basics; design brief fundamentals.

Unit II
Interior spaces classification; functional zoning; circulation patterns; spatial hierarchy; public, private, service spaces; human activities mapping; adjacency requirements; spatial relationships; volumetric perception; enclosure types; interior spatial organization principles; context sensitivity.

Unit III

Interior elements including floor, wall, ceiling; openings, doors, windows; fixed and movable components; surface articulation; visual continuity; structural versus non structural elements; interior components integration; basic joinery concepts; service interface awareness.

Unit IV

Furniture basics; fixed, loose furniture; furniture functions; anthropometric relevance; furniture arrangement principles; relationship with space usage; scale, proportion; furniture materials overview; ergonomic considerations; circulation clearance norms; functional layouts.

Unit V

Interior design process stages; site analysis; user requirement study; concept development; schematic planning; design development; basic documentation awareness; coordination with services; execution overview; post occupancy considerations; professional communication fundamentals.

Text Books

1. Ballast, D. K. (2014). *Interior design reference manual* (6th ed.). Professional Publications.
2. Ching, F. D. K., & Binggeli, C. (2018). *Interior design illustrated* (4th ed.). Wiley.
3. Piotrowski, C. M. (2014). *Professional practice for interior designers* (6th ed.). Wiley.
4. Kilmer, R., & Kilmer, W. O. (2014). *Designing interiors* (2nd ed.). Wiley.
5. Pile, J. (2013). *Interior design* (5th ed.). Pearson.

Reference Books

1. Brooker, G., & Stone, S. (2018). *Basics interior architecture 01: Form + structure*. Bloomsbury.
2. Lawson, B. (2005). *How designers think* (4th ed.). Architectural Press.
3. Malnar, J. M., & Vodvarka, F. (2004). *Sensory design*. University of Minnesota Press.
4. Lawson, F. (2001). *Hotels and resorts: Planning and design*. Architectural Press.
5. Abercrombie, S. (1990). *A philosophy of interior design*. Harper & Row.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Elements & Principles of Design

Course Category: Design Foundations & Theory
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To impart knowledge of fundamental design elements.
2. To develop understanding of design principles in visual compositions.
3. To relate elements and principles to interior design applications.
4. To enhance visual sensitivity and aesthetic judgment.
5. To support design decision-making through structured principles.

Course Outcomes

- CO1: Identify and define core elements of design.
- CO2: Apply principles of design in visual compositions.
- CO3: Analyze interior spaces using design principles.
- CO4: Integrate elements and principles in design solutions.
- CO5: Evaluate aesthetic balance in interior contexts.

Detailed Syllabus

Unit I
Elements of design; line types; horizontal, vertical, diagonal, curved lines; visual direction; line expression; plane definition; shape classification; geometric, organic forms; point concept; visual emphasis; spatial implication; interior relevance.

Unit II
Form and mass; three dimensional forms; solid, void relationships; volume perception; positive, negative spaces; texture types; tactile, visual textures; material expression; surface articulation; interior materiality; sensory perception.

Unit III
Colour fundamentals; hue, value, intensity; colour wheel; primary, secondary, tertiary colours; colour interactions; psychological effects; cultural associations; colour in interiors; visual comfort; spatial impact; lighting interaction.

Unit IV
Principles of design; balance types; symmetry, asymmetry; rhythm; repetition, progression; emphasis; focal points; hierarchy; proportion; scale relationships; interior compositions; visual stability; harmony concepts.

Unit V
Unity and contrast; dominance and subordination; movement; transition; gestalt principles;

figure ground relationships; visual continuity; application in interior layouts; design coherence; aesthetic evaluation frameworks.

Text Books

1. Ocvirk, O. G., Stinson, R. E., Wigg, P. R., Bone, R. O., & Cayton, D. L. (2017). *Art fundamentals: Theory and practice* (13th ed.). McGraw-Hill.
2. Lauer, D. A., & Pentak, S. (2015). *Design basics* (8th ed.). Cengage Learning.
3. Wong, W. (1993). *Principles of form and design*. Wiley.
4. Zelanski, P., & Fisher, M. (2011). *Color* (6th ed.). Pearson.
5. Pile, J. (1997). *Color in interior design*. McGraw-Hill.

Reference Books

1. Ching, F. D. K. (2014). *Architecture: Form, space, and order* (4th ed.). Wiley.
2. Itten, J. (2004). *The art of color*. Wiley.
3. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design* (2nd ed.). Rockport.
4. Bangs, D. (2012). *Visual literacy*. Cengage Learning.
5. Porter, T. (2004). *Color planning for interiors*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Course 3: Freehand Drawing & Visual Communication

Course Category: Design Foundations & Theory
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop freehand drawing skills for visual expression.
2. To understand drawing as a tool for design communication.
3. To enhance observation and proportion skills.
4. To apply visual communication techniques in interior contexts.
5. To support studio based design development.

Course Outcomes

- CO1: Demonstrate basic freehand drawing proficiency.
- CO2: Apply observational drawing techniques accurately.
- CO3: Communicate design ideas through sketches.
- CO4: Use drawing conventions for interior representation.
- CO5: Integrate visual communication in design processes.

Detailed Syllabus

Unit I
Introduction to freehand drawing; importance in design process; drawing tools and media; line quality; line weight variation; hand eye coordination; basic strokes; sketching discipline; visual observation skills; drawing control development.

Unit II
Shape and form exploration; geometric and organic forms; proportion principles; scale relationships; positive negative space; composition basics; visual balance; spatial awareness; drawing accuracy improvement.

Unit III
Perspective fundamentals; one point perspective concepts; horizon line; vanishing point; depth representation; simple interior spaces; visual alignment; proportion control; spatial visualization skills.

Unit IV
Light and shade; tonal values; shading techniques; hatching, cross hatching; texture representation; material indication basics; surface quality; visual depth enhancement; realism in sketches.

Unit V
Visual communication techniques; concept sketches; diagrammatic drawings; annotation methods; interior sketching from reference; furniture sketch basics; presentation clarity; visual storytelling fundamentals.

Text Books

1. Ching, F. D. K., & Juroszek, S. P. (2010). *Design drawing*. Wiley.
2. Porter, T. (2005). *Architectural drawing*. Architectural Press.
3. Yee, R. (2014). *Architectural drawing* (3rd ed.). Wiley.
4. Dondis, D. A. (1973). *A primer of visual literacy*. MIT Press.
5. Laseau, P. (2000). *Graphic thinking for architects and designers*. Wiley.

Reference Books

1. Pickup, J., & Pickup, J. (2007). *Drawing workshop*. Batsford.

2. Robbins, E. (1994). *Why architects draw*. MIT Press.
3. Pipes, A. (2003). *Foundations of art and design*. Laurence King.
4. Wong, W. (1993). *Principles of form and design*. Wiley.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Evaluation Scheme

Continuous Assessment (50%) + End-Semester Examination (50%)

Building Materials & Construction – I

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce basic building materials used in interior construction.
2. To understand material properties and selection criteria.
3. To familiarize construction methods for building components.
4. To relate materials to functional and aesthetic requirements.
5. To develop material literacy for interior applications.

Course Outcomes

- CO1: Identify common building materials and classifications.
- CO2: Understand properties influencing material performance.
- CO3: Apply material knowledge to basic construction elements.
- CO4: Analyze suitability of materials for interior use.
- CO5: Interpret basic construction techniques.

Detailed Syllabus

Unit I
Building materials overview; classification; natural, manufactured materials; stone types; properties, uses; quarrying methods; stone masonry basics; bonding principles; stone finishes; durability considerations; interior applicability; limitations.

Unit II
Bricks and blocks; clay products; brick manufacturing; properties; types; bonding patterns; mortar basics; cement, lime; composition; setting; strength; interior partition relevance; thermal performance; dimensional standards.

Unit III
Cement types; Portland cement; admixtures; concrete ingredients; aggregates; water cement ratio; basic concrete properties; concrete blocks; precast elements; interior construction usage; structural awareness; surface finishes.

Unit IV
Timber materials; hardwood, softwood; properties; seasoning methods; defects; preservation techniques; timber sections; joinery relevance; interior furniture interface; sustainability aspects; engineered wood overview.

Unit V
Metal materials; ferrous, non ferrous metals; steel, aluminum properties; corrosion; protection methods; glass types; properties; basic glass manufacturing; glazing relevance; interior partitions; safety considerations.

Text Books

1. Rangwala, S. C. (2013). *Building materials* (26th ed.). Charotar Publishing.
2. Arora, S. P., & Bindra, S. P. (2012). *Building construction* (Vol. 1). Dhanpat Rai.
3. Varghese, P. C. (2015). *Building materials*. PHI Learning.
4. Duggal, S. K. (2017). *Building materials* (4th ed.). New Age International.
5. McKay, W. B. (2010). *Building construction*. Pearson.

Reference Books

1. Barry, R. (2018). *The construction of buildings* (7th ed.). Wiley Blackwell.
2. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.
3. Chudley, R., & Greeno, R. (2014). *Building construction handbook* (10th ed.). Routledge.
4. Illston, J. M. (2009). *Construction materials*. CRC Press.
5. Ashby, M. (2011). *Materials selection in mechanical design*. Butterworth Heinemann.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

History of Architecture & Interiors

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce historical development of architecture and interiors.

2. To understand stylistic evolution across civilizations.
3. To relate historical styles to interior elements.
4. To develop visual and contextual awareness.
5. To build reference base for contemporary design.

Course Outcomes

- CO1: Identify major architectural periods.
- CO2: Understand interior characteristics of historical styles.
- CO3: Relate social context to design evolution.
- CO4: Analyze spatial and decorative features.
- CO5: Apply historical references in design thinking.

Detailed Syllabus

Unit I
Prehistoric and ancient civilizations; Egyptian, Mesopotamian architecture; materials, construction; interior spaces; columns, walls; symbolic ornamentation; spatial hierarchy; domestic interiors; cultural influence; functional layouts.

Unit II
Classical architecture; Greek orders; Roman innovations; arches, vaults; interior planning; public buildings; materials; proportions; decorative elements; furniture influence; spatial organization principles.

Unit III
Medieval period; Romanesque, Gothic styles; structural systems; interiors of churches; vaulting; stained glass; ornamentation; spatial verticality; material expression; symbolic interiors.

Unit IV
Renaissance and Baroque; revival of classical principles; symmetry; proportion; palaces; interior decoration; frescoes; furniture styles; ornamentation richness; spatial drama; material usage.

Unit V
Modern movements overview; industrial revolution impact; Arts and Crafts; Modernism basics; interior simplification; functionalism; material honesty; transition to contemporary interiors; stylistic legacy.

Text Books

1. Fletcher, B. (2019). *A history of architecture* (21st ed.). Architectural Press.

2. Trachtenberg, M., & Hyman, I. (2003). *Architecture: From prehistory to postmodernity*. Prentice Hall.
3. Kostof, S. (1995). *A history of architecture*. Oxford University Press.
4. Pile, J. (2005). *A history of interior design* (2nd ed.). Wiley.
5. Bannister Fletcher, D. (2014). *Global history of architecture*. Wiley.

Reference Books

1. Watkin, D. (2005). *A history of Western architecture*. Laurence King.
2. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.
3. Summerson, J. (1993). *The classical language of architecture*. MIT Press.
4. Curtis, W. (1996). *Modern architecture since 1900*. Phaidon.
5. Honour, H., & Fleming, J. (2009). *A world history of art*. Laurence King.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To enhance professional English language proficiency.
2. To develop effective oral and written communication skills.
3. To improve listening and presentation abilities.
4. To build confidence in professional interactions.
5. To support academic and design communication needs.

Course Outcomes

- CO1: Use English effectively in professional contexts.
- CO2: Prepare structured written communications.
- CO3: Demonstrate effective oral presentation skills.
- CO4: Apply listening and interpersonal communication techniques.
- CO5: Communicate design ideas clearly.

Detailed Syllabus

Unit I
Basics of communication; process; barriers; verbal, non verbal communication; professional context; vocabulary building; pronunciation basics; clarity; tone; audience awareness; communication ethics.

Unit II
Listening skills; active listening; note taking; comprehension; speaking skills; conversation techniques; group discussions; confidence building; articulation; fluency development.

Unit III
Reading skills; skimming; scanning; comprehension strategies; professional texts; design related content; vocabulary enrichment; interpretation; critical reading basics.

Unit IV
Writing skills; sentence structure; paragraph organization; formal writing; emails; reports; resumes; cover letters; professional documentation; clarity and coherence.

Unit V
Presentation skills; visual aids; public speaking; body language; voice modulation; design presentations; interviews; professional etiquette; teamwork communication.

Text Books

1. Raman, M., & Sharma, S. (2015). *Technical communication* (2nd ed.). Oxford University Press.
2. Bhatia, V. K. (2014). *Professional communication*. Pearson.
3. Murphy, R. (2019). *English grammar in use* (5th ed.). Cambridge.
4. Swan, M. (2016). *Practical English usage* (4th ed.). Oxford.
5. Bailey, S. (2018). *Academic writing* (5th ed.). Routledge.

Reference Books

1. Lucas, S. (2015). *The art of public speaking*. McGraw-Hill.
2. Comfort, J., Revell, R., & Stott, C. (2013). *English for the telephone*. Oxford.
3. Guffey, M. E., & Loewy, D. (2016). *Business communication*. Cengage.
4. Hewings, M. (2013). *Advanced grammar in use*. Cambridge.
5. Thill, J. V., & Bovee, C. L. (2014). *Excellence in business communication*. Pearson.

Evaluation Scheme

Continuous Assessment (50%) + End-SEMESTER Examination (50%)

Design Studio – I

Course Category: Core Engineering Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To develop basic design thinking through studio practice.
2. To enhance visual expression skills.
3. To apply theory concepts in practical exercises.
4. To build confidence in manual design exploration.
5. To introduce studio culture and critique.

Course Outcomes

- CO1: Demonstrate basic design exploration skills.
- CO2: Apply elements and principles in studio work.
- CO3: Communicate ideas through drawings and models.
- CO4: Respond to design briefs effectively.
- CO5: Participate in critiques and evaluations.

List of Experiments / Exercises *(10 Exercises)*

1. Exploration of line, point, plane through freehand compositions using manual drawing tools, focusing on control, variation, and visual expression.
2. Development of two dimensional compositions using basic shapes, applying balance, rhythm, and emphasis in controlled studio exercises.
3. Colour application studies using dry and wet media, exploring harmony, contrast, and psychological impact in abstract compositions.
4. Texture exploration through shading, hatching, and material rubbings, emphasizing tactile and visual representation skills.
5. Form development exercises translating two dimensional compositions into simple three dimensional paper models.
6. Spatial organization studies using basic volumes, focusing on positive and negative space relationships.
7. Furniture sketching basics from observation, emphasizing proportion, scale, and line quality.
8. Interior space sketching from reference images, focusing on perspective awareness and depth.

9. Concept translation exercise from written brief to visual composition, emphasizing idea clarity.
10. Studio critique and refinement exercise, incorporating feedback, presentation, and visual improvement techniques.

Expected Outcomes

Improved visual thinking; enhanced manual drawing skills; application of design principles; confidence in studio presentation; readiness for advanced studios.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER II

Design Drawing & Drafting Techniques

Course Category: Design Foundations & Theory
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To develop proficiency in technical drawing for interior design.
2. To understand drafting standards and conventions.
3. To apply drawing techniques for spatial representation.
4. To enhance accuracy and clarity in design documentation.
5. To prepare students for advanced design studios.

Course Outcomes

- CO1: Apply drafting tools and techniques accurately.
- CO2: Produce scaled interior drawings.
- CO3: Interpret architectural and interior drawings.
- CO4: Follow standard drawing conventions.
- CO5: Communicate design intent through drawings.

Detailed Syllabus

Unit I
Introduction to drafting; drawing instruments; sheet layout; line types; lettering standards; BIS conventions; scales; scale selection; reduction, enlargement methods; dimensioning principles; accuracy control; drafting discipline.

Unit II
Orthographic projection principles; plan, elevation, section concepts; projection methods; first angle projection; reference planes; interior layout drawings; sectional representation basics; drawing interpretation skills.

Unit III
Interior plans; furniture layouts; circulation indication; door, window symbols; dimensioning norms; annotation methods; spatial clarity; functional zoning drawings; drawing coordination.

Unit IV
Sections and elevations; cutting plane concepts; interior elevations; wall treatments; ceiling

representation; material indication symbols; levels; height control; vertical dimensioning standards.

Unit V
Introduction to perspective drawing; one point, two point perspective; interior perspective construction; eye level; vanishing points; proportion control; visual depth representation; presentation clarity.

Text Books

1. Ching, F. D. K. (2015). *Architectural graphics* (6th ed.). Wiley.
2. Yee, R. (2014). *Architectural drawing* (3rd ed.). Wiley.
3. Gill, P. S. (2012). *Engineering drawing* (15th ed.). Katson.
4. Madsen, D. A., & Madsen, D. P. (2016). *Engineering drawing and design* (6th ed.). Cengage.
5. Goel, B. S. (2011). *Engineering drawing*. Krishna Prakashan.

Reference Books

1. French, T. E., Vierck, C. J., & Foster, R. J. (2008). *Engineering drawing and design*. McGraw-Hill.
2. Shah, M. B., & Rana, B. C. (2014). *Engineering drawing*. Pearson.
3. Ching, F. D. K., & Juroszek, S. P. (2010). *Design drawing*. Wiley.
4. Pickup, J., & Pickup, J. (2007). *Drawing workshop*. Batsford.
5. Porter, T. (2005). *Architectural drawing*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Building Materials & Construction – II

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To extend knowledge of construction systems and materials.
2. To understand interior construction techniques.
3. To relate materials to performance and detailing.
4. To develop construction literacy for interiors.

5. To support studio and site applications.

Course Outcomes

- CO1: Identify advanced interior construction materials.
- CO2: Understand construction methods for interior components.
- CO3: Apply material knowledge to detailing.
- CO4: Analyze performance requirements.
- CO5: Interpret construction drawings.

Detailed Syllabus

Unit I
Wall construction systems; load bearing, framed structures; partition walls; brick, block, drywall systems; fixing methods; finishes interface; acoustic considerations; interior adaptability.

Unit II
Flooring materials; stone, tile, wood, resilient flooring; sub floor preparation; laying techniques; joints; skirting details; performance factors; maintenance considerations.

Unit III
Ceiling systems; false ceilings; gypsum, mineral fiber, metal ceilings; suspension systems; lighting coordination; access panels; acoustic performance; interior aesthetics.

Unit IV
Doors and windows; types; materials; frames, shutters; hardware basics; installation methods; glazing systems; performance criteria; safety considerations.

Unit V
Staircases basics; types; materials; interior relevance; railing systems; finishes; waterproofing basics; damp proofing concepts; interior construction coordination.

Text Books

1. Rangwala, S. C. (2013). *Building construction* (26th ed.). Charotar Publishing.
2. Arora, S. P., & Bindra, S. P. (2012). *Building construction*. Dhanpat Rai.
3. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
4. Varghese, P. C. (2015). *Building materials*. PHI Learning.
5. McKay, W. B. (2010). *Building construction*. Pearson.

Reference Books

1. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
2. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.

3. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
4. Illston, J. M. (2009). *Construction materials*. CRC Press.
5. Ashby, M. (2011). *Materials selection in mechanical design*. Butterworth Heinemann.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Furniture Design Fundamentals

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce fundamentals of furniture design.
2. To understand furniture types and functions.
3. To relate ergonomics to furniture dimensions.
4. To study materials and construction methods.
5. To integrate furniture with interior spaces.

Course Outcomes

- CO1: Identify furniture categories and functions.
- CO2: Apply ergonomic principles in furniture design.
- CO3: Understand furniture materials and construction.
- CO4: Analyze furniture layout in interiors.
- CO5: Develop basic furniture concepts.

Detailed Syllabus

Unit I
Furniture history overview; traditional, modern furniture; classification; residential, commercial furniture; functional requirements; relationship with interior spaces; user needs analysis.

Unit II
Anthropometry basics; ergonomic principles; seating, tables, storage dimensions; comfort factors; posture considerations; circulation clearances; functional efficiency.

Unit III
Furniture materials; wood, metal, plastics; properties; selection criteria; finishes; durability; sustainability considerations; interior compatibility.

Unit IV
Construction methods; joinery basics; carpentry joints; fasteners; modular furniture concepts; knock down systems; manufacturing overview.

Unit V
Furniture layout planning; space relationship; circulation; grouping principles; aesthetics; furniture detailing basics; presentation methods.

Text Books

1. Kilmer, R., & Kilmer, W. O. (2014). *Designing interiors*. Wiley.
2. Pile, J. (2013). *Interior design*. Pearson.
3. Panero, J., & Zelnik, M. (2014). *Human dimension and interior space*. Watson-Guptill.
4. Ray, S. (2011). *Furniture design*. McGraw-Hill.
5. Green, W. (2006). *Furniture design*. Laurence King.

Reference Books

1. Fiell, C., & Fiell, P. (2014). *Design of the 20th century*. Taschen.
2. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
3. Dormer, P. (1993). *The culture of craft*. Manchester University Press.
4. Madsen, D. (2016). *Engineering drawing and design*. Cengage.
5. Ashby, M., & Johnson, K. (2010). *Materials and design*. Butterworth Heinemann.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Colour Theory & Interior Styling

Course Category: Design Foundations & Theory
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand theoretical foundations of colour.
2. To study psychological and cultural aspects of colour.
3. To apply colour principles in interior environments.
4. To develop interior styling sensibilities.
5. To support colour based design decision making.

Course Outcomes

- CO1: Identify colour properties and relationships.
- CO2: Apply colour harmonies in interiors.
- CO3: Analyze psychological impact of colour schemes.
- CO4: Integrate colour with materials and lighting.
- CO5: Develop interior styling concepts using colour.

Detailed Syllabus

Unit I
Colour fundamentals; hue, value, intensity; colour spectrum; primary, secondary, tertiary colours; colour wheel construction; additive, subtractive systems; colour notation; basic terminology; visual perception fundamentals.

Unit II
Colour harmony principles; monochromatic, analogous, complementary, split complementary schemes; warm and cool colours; balance and contrast; colour dominance; visual emphasis; spatial effects; interior composition relevance.

Unit III
Psychological effects of colour; emotional responses; behavioural influence; cultural symbolism; colour associations; social context; functional suitability; colour selection considerations for interior environments.

Unit IV
Colour and materials; surface texture interaction; gloss, matte finishes; material reflectance; light colour interaction; natural and artificial lighting influence; colour consistency; interior finish coordination.

Unit V
Interior styling concepts; colour palettes; mood boards; residential and commercial applications; trend awareness; branding through colour; visual identity; presentation techniques; professional styling practices.

Text Books

1. Pile, J. (1997). *Color in interior design*. McGraw-Hill.
2. Porter, T. (2004). *Color planning for interiors*. Architectural Press.
3. Itten, J. (2004). *The art of color*. Wiley.
4. Zelanski, P., & Fisher, M. (2011). *Color*. Pearson.
5. Wong, W. (1993). *Principles of form and design*. Wiley.

Reference Books

1. Ching, F. D. K. (2014). *Architecture: Form, space, and order*. Wiley.
2. Ocvirk, O. G., et al. (2017). *Art fundamentals*. McGraw-Hill.
3. Bangs, D. (2012). *Visual literacy*. Cengage Learning.
4. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design*. Rockport.
5. Abercrombie, S. (1990). *A philosophy of interior design*. Harper & Row.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Computer Fundamentals for Designers

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce basic computer concepts for designers.
2. To understand digital tools used in design workflows.
3. To develop data handling and presentation skills.
4. To apply computer fundamentals in design documentation.
5. To prepare for advanced digital design applications.

Course Outcomes

- CO1: Understand computer system components and functions.
- CO2: Use operating systems effectively for design tasks.
- CO3: Apply basic software tools for documentation.
- CO4: Manage digital data and files efficiently.
- CO5: Integrate computing skills into design processes.

Detailed Syllabus

Unit I
Computer fundamentals; hardware components; input, output devices; CPU functions; memory types; storage devices; system performance basics; relevance to design applications.

Unit II
Operating systems concepts; file management; directory structures; software installation; system utilities; user interface basics; workflow organization for designers.

Unit III
Office productivity tools; word processing; spreadsheets; presentations; formatting; tables; charts; documentation standards; interior design reporting usage.

Unit IV
Digital data handling; file formats; image resolution basics; raster, vector awareness; data backup methods; storage management; digital security fundamentals.

Unit V
Internet and communication tools; email etiquette; cloud storage; online collaboration; digital research methods; professional digital practices; ethical usage awareness.

Text Books

1. Norton, P. (2014). *Introduction to computers*. McGraw-Hill.
2. Shelly, G. B., & Vermaat, M. (2016). *Discovering computers*. Cengage Learning.
3. Morley, D., & Parker, C. (2015). *Understanding computers*. Cengage Learning.
4. Jain, V. K. (2012). *Computer fundamentals*. BPB Publications.
5. Rajaraman, V. (2014). *Introduction to information technology*. PHI Learning.

Reference Books

1. Sinha, P. K. (2010). *Computer fundamentals*. BPB Publications.
2. Laudon, K. C., & Laudon, J. P. (2016). *Management information systems*. Pearson.
3. Turban, E. (2017). *Information technology for management*. Wiley.
4. Shelly, G. B. (2016). *Microsoft Office fundamentals*. Cengage Learning.
5. Stair, R., & Reynolds, G. (2018). *Principles of information systems*. Cengage.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Creativity

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce design thinking methodologies.
2. To enhance creative problem solving abilities.
3. To develop user centered design approaches.

4. To encourage innovation in design processes.
5. To support interdisciplinary creative thinking.

Course Outcomes

- CO1: Understand principles of design thinking.
- CO2: Apply creative problem solving techniques.
- CO3: Analyze user needs and contexts.
- CO4: Generate innovative design ideas.
- CO5: Integrate creativity into design workflows.

Detailed Syllabus

Unit I
Design thinking overview; definition; relevance; stages; empathize, define, ideate, prototype, test; creative mindset; problem framing; interior design context.

Unit II
Creativity concepts; divergent, convergent thinking; barriers to creativity; lateral thinking techniques; brainstorming methods; idea generation tools; creative confidence.

Unit III
User centered design; empathy mapping; user research basics; observation techniques; need identification; persona development; interior application relevance.

Unit IV
Ideation and prototyping; sketching ideas; low fidelity prototypes; iterative development; feedback integration; evaluation criteria; refinement strategies.

Unit V
Innovation in practice; case awareness; interdisciplinary collaboration; design ethics; sustainability linkage; professional creativity; lifelong learning orientation.

Text Books

1. Brown, T. (2009). *Change by design*. HarperCollins.
2. Cross, N. (2011). *Design thinking*. Berg.
3. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown Business.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design*. Rockport.

Reference Books

1. Buchanan, R. (1992). *Wicked problems in design thinking*. Design Issues.

2. Norman, D. (2013). *The design of everyday things*. Basic Books.
3. Manzini, E. (2015). *Design, when everybody designs*. MIT Press.
4. Verganti, R. (2009). *Design driven innovation*. Harvard Business Press.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship / Site Orientation

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To expose students to real site environments.
2. To understand basic construction practices.
3. To observe professional workflows.
4. To develop site safety awareness.
5. To relate theory with practice.

Course Outcomes

- CO1: Identify site activities and processes.
- CO2: Observe material usage and construction methods.
- CO3: Follow basic site safety practices.
- CO4: Document site observations.
- CO5: Relate academic learning to industry practice.

Guidelines

Site visits; supervised observation; activity log maintenance; faculty review; industry interaction.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER III

Space Planning & Ergonomics

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To develop understanding of space planning principles.
2. To apply ergonomic data to interior layouts.
3. To relate human activities with spatial requirements.
4. To integrate circulation and functional efficiency.
5. To support residential and commercial interior planning.

Course Outcomes

- CO1: Analyze spatial requirements for interior functions.
- CO2: Apply ergonomic standards in layouts.
- CO3: Develop efficient circulation patterns.
- CO4: Interpret anthropometric data for design.
- CO5: Prepare functional space plans.

Detailed Syllabus

Unit I
Space planning fundamentals; objectives; factors influencing planning; user needs; activity analysis; spatial standards; adjacency relationships; zoning concepts; circulation hierarchy; efficiency criteria; interior planning framework.

Unit II
Anthropometry basics; static and dynamic dimensions; reach, clearance, posture data; ergonomic principles; application in interiors; seating, working, movement spaces; comfort parameters; safety considerations.

Unit III
Residential space planning; living, dining, bedroom, kitchen spaces; functional relationships; furniture clearances; circulation paths; privacy gradients; flexibility; efficiency optimization; spatial sequencing.

Unit IV
Commercial space planning basics; offices, retail layouts; workflow analysis; user density;

circulation efficiency; ergonomic compliance; service integration; spatial branding considerations; adaptability requirements.

Unit V
Barrier free design basics; accessibility principles; universal design concepts; anthropometric diversity; circulation widths; furniture adaptation; safety norms; inclusive interior planning awareness.

Text Books

1. Panero, J., & Zelnik, M. (2014). *Human dimension and interior space*. Watson-Guptill.
2. Kilmer, R., & Kilmer, W. O. (2014). *Designing interiors*. Wiley.
3. Neufert, E. (2012). *Architects' data* (4th ed.). Wiley Blackwell.
4. Pile, J. (2013). *Interior design*. Pearson.
5. Grandjean, E. (1988). *Fitting the task to the man*. Taylor & Francis.

Reference Books

1. Bridger, R. S. (2008). *Introduction to ergonomics*. CRC Press.
2. Lawson, B. (2005). *How designers think*. Architectural Press.
3. Ching, F. D. K. (2014). *Architecture: Form, space, and order*. Wiley.
4. Oborne, D. J. (1995). *Ergonomics at work*. Wiley.
5. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design*. Rockport.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Residential Interior Design

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand residential interior typologies.
2. To develop planning skills for dwelling units.
3. To integrate user needs and lifestyle factors.
4. To apply materials and furniture appropriately.

5. To prepare complete residential design concepts.

Course Outcomes

- CO1: Identify residential interior requirements.
- CO2: Prepare functional residential layouts.
- CO3: Apply ergonomic and aesthetic principles.
- CO4: Integrate services and furniture.
- CO5: Present residential interior concepts.

Detailed Syllabus

Unit I
Residential typologies; apartments, villas; user profiling; family structures; lifestyle analysis; design considerations; functional zoning; privacy gradients; space standards; planning constraints.

Unit II
Living and dining interiors; space organization; furniture layouts; circulation; lighting basics; material selection; aesthetics; flexibility; social interaction spaces.

Unit III
Bedroom interiors; master, children, guest rooms; storage planning; wardrobes; ergonomic comfort; lighting; privacy; personalization; functional detailing.

Unit IV
Kitchen and utility planning; work triangle; storage systems; appliances integration; finishes; safety; ventilation; ergonomic efficiency; service coordination.

Unit V
Bathroom interiors; sanitary fixtures; layouts; plumbing coordination; finishes; waterproofing awareness; lighting; ventilation; universal design basics.

Text Books

1. Pile, J. (2013). *Interior design*. Pearson.
2. Ching, F. D. K., & Binggeli, C. (2018). *Interior design illustrated*. Wiley.
3. Kilmer, R., & Kilmer, W. O. (2014). *Designing interiors*. Wiley.
4. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
5. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.

Reference Books

1. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
2. Abercrombie, S. (1990). *A philosophy of interior design*. Harper & Row.

3. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. Porter, T. (2004). *Color planning for interiors*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Building Services – I (Plumbing & Sanitation)

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce plumbing and sanitation systems.
2. To understand water supply and drainage principles.
3. To integrate services with interior planning.
4. To develop basic service coordination skills.
5. To support functional interior design solutions.

Course Outcomes

- CO1: Identify plumbing system components.
- CO2: Understand sanitation layouts.
- CO3: Apply service planning in interiors.
- CO4: Coordinate fixtures and fittings.
- CO5: Interpret basic service drawings.

Detailed Syllabus

Unit I
Water supply systems; sources; distribution methods; pipes, fittings; storage tanks; pressure considerations; domestic water requirements; interior coordination basics.

Unit II
Plumbing fixtures; water closets; wash basins; sinks; baths; material types; installation principles; spacing norms; ergonomic considerations; interior interface.

Unit III
Sanitation systems; drainage principles; traps; vents; soil, waste pipes; gradients; inspection chambers; odor control; interior relevance.

Unit IV
Sewage disposal basics; municipal connections; septic tanks; basic treatment awareness; sustainability considerations; water conservation concepts.

Unit V
Plumbing drawings; symbols; layout interpretation; coordination with interiors; maintenance access; safety; service planning integration.

Text Books

1. Rangwala, S. C. (2014). *Building services*. Charotar Publishing.
2. Arora, S. P., & Bindra, S. P. (2012). *Building construction*. Dhanpat Rai.
3. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
4. Varghese, P. C. (2015). *Building construction*. PHI Learning.
5. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.

Reference Books

1. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
2. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.
3. Hall, F. (2010). *Building services and equipment*. Pearson.
4. McKay, W. B. (2010). *Building construction*. Pearson.
5. Ashby, M. (2011). *Materials selection in mechanical design*. Butterworth Heinemann.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Lighting Design & Acoustics

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand principles of lighting design in interiors.
2. To study visual comfort and illumination requirements.
3. To introduce fundamentals of architectural acoustics.
4. To integrate lighting and acoustics with interior planning.
5. To support functional and aesthetic interior environments.

Course Outcomes

- CO1: Identify lighting requirements for interior spaces.
- CO2: Apply basic lighting design principles.
- CO3: Understand acoustic behavior in enclosed spaces.
- CO4: Integrate lighting and acoustics in interior layouts.
- CO5: Analyze comfort and performance parameters.

Detailed Syllabus

Unit I
Lighting fundamentals; nature of light; luminous flux, intensity, illuminance; inverse square law; reflection, absorption; visual comfort parameters; glare control; illumination standards; interior lighting requirements; functional performance criteria.

Unit II
Natural lighting concepts; daylight availability; orientation influence; window design; daylight factor; glare prevention; shading devices; interior daylight planning; visual comfort optimization; energy efficiency considerations.

Unit III
Artificial lighting systems; lamps, luminaires; incandescent, fluorescent, LED sources; colour temperature; colour rendering index; distribution patterns; lighting layouts; interior application criteria; maintenance factors.

Unit IV
Acoustics fundamentals; nature of sound; sound propagation; frequency; decibel scale; reflection, absorption, transmission; reverberation; noise sources; acoustic comfort parameters; interior relevance.

Unit V
Acoustic design strategies; sound insulation; absorptive materials; ceiling, wall treatments; noise control methods; auditoria, offices, residential interiors; acoustic detailing basics; integration with interior design.

Text Books

1. Steffy, G. (2013). *Architectural lighting design*. Wiley.
2. DiLaura, D., Houser, K., Mistrick, R., & Steffy, G. (2011). *The lighting handbook*. IESNA.
3. Long, M. (2014). *Architectural acoustics*. Elsevier.
4. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
5. Boyce, P. (2014). *Human factors in lighting*. CRC Press.

Reference Books

1. Hall, F. (2010). *Building services and equipment*. Pearson.
2. Everest, F. A., & Pohlmann, K. C. (2015). *Master handbook of acoustics*. McGraw-Hill.
3. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
4. Clements-Croome, D. (2014). *Intelligent buildings*. ICE Publishing.
5. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Computer-Aided Design (AutoCAD)

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop proficiency in CAD software for interior design.
2. To understand digital drafting standards and workflows.
3. To apply CAD tools for interior documentation.
4. To enhance accuracy and efficiency in drawings.
5. To support studio and professional design outputs.

Course Outcomes

- CO1: Use CAD interface and commands effectively.
- CO2: Prepare accurate interior drawings digitally.
- CO3: Apply layers, blocks, and annotations.
- CO4: Generate plans, sections, and elevations.
- CO5: Produce print ready drawing outputs.

List of Experiments / Exercises *(12 Experiments)*

1. Introduction to CAD environment, user interface navigation, coordinate systems, drawing setup, units configuration, and workspace customization for interior drafting tasks.
2. Practice of basic drawing commands including line, polyline, circle, arc, rectangle, and modify commands focusing on precision and accuracy.

3. Application of object snap, grid, ortho, and polar tracking tools to improve drawing control and drafting efficiency.
4. Creation and management of layers including naming conventions, color coding, line types, and layer based organization for interior drawings.
5. Drafting of basic interior floor plan with walls, openings, and furniture layout using appropriate dimensions and scaling methods.
6. Development of blocks for doors, windows, furniture symbols, and reuse of standardized components in interior layouts.
7. Preparation of dimensioning and annotation using text styles, dimension styles, leaders, and notation standards.
8. Drawing of interior elevations showing wall treatments, finishes, and vertical dimensions using projection techniques.
9. Preparation of sectional drawings indicating floor, ceiling, and service relationships in interior spaces.
10. Layout setup for plotting including viewports, paper space management, title blocks, and scale control.
11. Application of hatching and pattern fills for materials, finishes, and surface differentiation in drawings.
12. Final compilation and printing of complete interior drawing set following professional documentation standards.

Expected Outcomes

Proficiency in digital drafting; accuracy in interior documentation; readiness for advanced CAD and BIM applications; professional drawing presentation skills.

Evaluation Scheme

Continuous Assessment (100%)

Humanities Elective (Aesthetics / Cultural Studies)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To develop understanding of aesthetics and cultural contexts.
2. To study visual perception and aesthetic judgment.
3. To relate cultural influences to interior design.

4. To enhance critical and reflective thinking.
5. To support culturally sensitive design approaches.

Course Outcomes

- CO1: Understand fundamental aesthetic concepts.
- CO2: Identify cultural influences on design.
- CO3: Analyze interiors from cultural perspectives.
- CO4: Apply aesthetic principles in design thinking.
- CO5: Demonstrate cultural sensitivity in design responses.

Detailed Syllabus

Unit I
Aesthetics fundamentals; meaning of beauty; form, proportion, harmony; visual perception; sensory experience; philosophical perspectives; relevance to interior environments; aesthetic judgment development.

Unit II
Elements of visual culture; art, craft, architecture; symbolism; meaning making; cultural expression; visual language; interior design interpretation.

Unit III
Cultural studies overview; culture, society, identity; traditions; rituals; social behavior; spatial expression; influence on built environments.

Unit IV
Indian cultural contexts; regional traditions; material usage; crafts; vernacular interiors; symbolism; continuity and change in design expression.

Unit V
Global cultural perspectives; cross cultural design awareness; globalization influence; contemporary cultural trends; ethical considerations; culturally responsive interior design.

Text Books

1. Scruton, R. (2009). *Beauty*. Oxford University Press.
2. Honour, H., & Fleming, J. (2009). *A world history of art*. Laurence King.
3. Barker, C. (2012). *Cultural studies*. Sage.
4. Pile, J. (2013). *Interior design*. Pearson.
5. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.

Reference Books

1. Arnheim, R. (1974). *Art and visual perception*. University of California Press.

2. Bourdieu, P. (1984). *Distinction*. Harvard University Press.
3. Hall, S. (1997). *Representation*. Sage.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. Abercrombie, S. (1990). *A philosophy of interior design*. Harper & Row.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To gain exposure to professional practice.
2. To observe interior design execution.
3. To understand coordination among disciplines.
4. To document industry practices.
5. To relate academic learning with field experience.

Course Outcomes

- CO1: Observe professional interior workflows.
- CO2: Identify materials and construction practices.
- CO3: Follow workplace discipline and safety.
- CO4: Maintain internship records.
- CO5: Reflect on industry learning.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER IV

Course 1: Commercial Interior Design

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand commercial interior typologies and functions.
2. To develop planning strategies for commercial spaces.
3. To integrate branding, circulation, and user experience.
4. To apply materials, lighting, and furniture appropriately.
5. To prepare comprehensive commercial interior concepts.

Course Outcomes

- CO1: Identify functional requirements of commercial interiors.
- CO2: Develop efficient commercial space plans.
- CO3: Integrate branding and spatial identity.
- CO4: Coordinate services and furniture layouts.
- CO5: Present commercial interior design proposals.

Detailed Syllabus

Unit I
Commercial interior overview; office, retail, hospitality typologies; user profiles; functional objectives; operational requirements; spatial efficiency; branding considerations; circulation patterns; regulatory constraints; interior planning framework.

Unit II
Office interiors; workstation planning; open, closed offices; meeting spaces; ergonomic standards; circulation efficiency; flexibility; acoustic considerations; lighting integration; service coordination.

Unit III
Retail interiors; store layouts; display systems; customer flow; visual merchandising; lighting strategies; material selection; branding expression; point of sale planning.

Unit IV
Hospitality interiors basics; restaurants, cafes; seating layouts; kitchen interface awareness; ambience creation; lighting; acoustics; material durability; service coordination; user comfort.

Unit V
Commercial documentation basics; layout drawings; sections; elevations; furniture plans; coordination with services; compliance awareness; presentation techniques; professional deliverables.

Text Books

1. Pile, J. (2013). *Interior design*. Pearson.
2. Kilmer, R., & Kilmer, W. O. (2014). *Designing interiors*. Wiley.
3. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
4. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
5. Lawson, F. (2001). *Restaurants, clubs and bars*. Architectural Press.

Reference Books

1. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
2. Abercrombie, S. (1990). *A philosophy of interior design*. Harper & Row.
3. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.
4. Curtis, W. (1996). *Modern architecture since 1900*. Phaidon.
5. Porter, T. (2004). *Color planning for interiors*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Building Services – II (HVAC & Fire Safety)

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce HVAC systems and fire safety fundamentals.
2. To understand thermal comfort and air distribution.
3. To integrate services within interior spaces.
4. To develop coordination awareness with building systems.
5. To support safe and efficient interior environments.

Course Outcomes

- CO1: Identify HVAC system components.

- CO2: Understand thermal comfort principles.
- CO3: Apply fire safety norms in interiors.
- CO4: Coordinate HVAC layouts with interiors.
- CO5: Interpret basic service drawings.

Detailed Syllabus

Unit I
HVAC fundamentals; thermal comfort parameters; temperature, humidity, air movement; indoor air quality; human comfort standards; interior relevance; system overview.

Unit II
Air conditioning systems; central, split systems; components; ducts; diffusers; return air; zoning concepts; interior coordination; acoustic considerations.

Unit III
Ventilation systems; natural, mechanical ventilation; air changes; exhaust systems; kitchens, toilets; interior integration; energy considerations.

Unit IV
Fire safety basics; fire causes; fire behavior; detection systems; alarms; sprinklers; fire fighting equipment; interior layout implications.

Unit V
Fire safety planning; means of escape; exit widths; signage; fire resistant materials; code awareness; coordination with interiors; safety compliance.

Text Books

1. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
2. Arora, S. P., & Bindra, S. P. (2012). *Building construction*. Dhanpat Rai.
3. Rangwala, S. C. (2014). *Building services*. Charotar Publishing.
4. McQuiston, F. C., Parker, J. D., & Spitler, J. D. (2005). *Heating, ventilating, and air conditioning*. Wiley.
5. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.

Reference Books

1. Hall, F. (2010). *Building services and equipment*. Pearson.
2. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
3. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.
4. ASHRAE. (2017). *HVAC fundamentals*. ASHRAE.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Furniture Design & Detailing

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop advanced understanding of furniture design.
2. To study furniture detailing and construction.
3. To integrate ergonomics and aesthetics.
4. To apply materials and joinery knowledge.
5. To support furniture documentation skills.

Course Outcomes

- CO1: Design furniture responding to functional needs.
- CO2: Apply ergonomic and dimensional standards.
- CO3: Prepare furniture details and drawings.
- CO4: Select appropriate materials and finishes.
- CO5: Integrate furniture within interior spaces.

Detailed Syllabus

Unit I
Furniture design process; functional analysis; user needs; concept development; form exploration; aesthetics; relationship with interior spaces; design constraints.

Unit II
Advanced ergonomics; seating comfort; work furniture; anthropometric data application; safety; usability; dimensional accuracy; circulation clearances.

Unit III
Furniture materials; wood derivatives; metal; upholstery; hardware; finishes; durability; sustainability considerations; material detailing.

Unit IV
Construction techniques; joinery details; fasteners; modular systems; knock down furniture; manufacturing methods; tolerance awareness.

Unit V
Furniture detailing drawings; plans, sections, elevations; exploded views; specification basics; documentation standards; presentation techniques.

Text Books

1. Panero, J., & Zelnik, M. (2014). *Human dimension and interior space*. Watson-Guptill.
2. Ray, S. (2011). *Furniture design*. McGraw-Hill.
3. Green, W. (2006). *Furniture design*. Laurence King.
4. Kilmer, R., & Kilmer, W. O. (2014). *Designing interiors*. Wiley.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. Dormer, P. (1993). *The culture of craft*. Manchester University Press.
2. Ashby, M., & Johnson, K. (2010). *Materials and design*. Butterworth Heinemann.
3. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
4. Madsen, D. (2016). *Engineering drawing and design*. Cengage.
5. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Interior Construction & Detailing

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand interior construction systems.
2. To study construction details for interior components.
3. To integrate materials and services.
4. To develop detailing and coordination skills.
5. To support execution-oriented design decisions.

Course Outcomes

- CO1: Identify interior construction systems.

- CO2: Prepare interior construction details.
- CO3: Coordinate materials and services.
- CO4: Analyze constructability issues.
- CO5: Interpret execution drawings.

Detailed Syllabus

Unit I
Interior partitions; drywall systems; paneling; fixing methods; finishes interface; acoustic considerations; flexibility; detailing principles.

Unit II
Ceiling construction details; gypsum, modular ceilings; suspension systems; lighting integration; access panels; coordination aspects.

Unit III
Floor construction details; raised floors; flooring layers; edge details; transitions; expansion joints; finish coordination.

Unit IV
Joinery details; doors, windows; frames; shutters; hardware integration; installation considerations; performance aspects.

Unit V
Staircase and railing details; materials; fixing; safety norms; detailing standards; coordination with interiors.

Text Books

1. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
2. Rangwala, S. C. (2013). *Building construction*. Charotar Publishing.
3. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
4. Varghese, P. C. (2015). *Building materials*. PHI Learning.
5. McKay, W. B. (2010). *Building construction*. Pearson.

Reference Books

1. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.
2. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
3. Illston, J. M. (2009). *Construction materials*. CRC Press.
4. Ashby, M. (2011). *Materials selection in mechanical design*. Butterworth Heinemann.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (Landscape Design / Set Design)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

OPTION A: LANDSCAPE DESIGN

Course Objectives

1. To introduce fundamentals of landscape design.
2. To understand outdoor spatial planning principles.
3. To study natural and built landscape elements.
4. To integrate landscape with built environments.
5. To develop basic landscape design literacy.

Course Outcomes

- CO1: Identify landscape design elements and principles.
- CO2: Analyze site conditions and outdoor spaces.
- CO3: Apply landscape concepts in design proposals.
- CO4: Integrate hardscape and softscape elements.
- CO5: Develop basic landscape design solutions.

Detailed Syllabus

Unit I
Landscape design definition, scope; relationship with architecture, interiors; natural, built landscapes; functional, aesthetic objectives; landscape typologies; residential, commercial, institutional landscapes; role of landscape designer; design process overview.

Unit II
Site analysis principles; topography, climate, soil; vegetation; water bodies; access, circulation; views, vistas; microclimate considerations; site constraints; opportunities; contextual response in landscape planning.

Unit III
Landscape elements; softscape components, trees, shrubs, ground cover; hardscape

components, paving, pathways, decks; material selection; textures, colors; spatial organization; scale, proportion in outdoor environments.

Unit IV
Landscape design principles; unity, balance, rhythm; hierarchy; focal points; movement; outdoor space enclosure; functional zoning; user activities; accessibility; safety considerations; sustainable landscape awareness.

Unit V
Landscape drawings; site plans; planting layouts; hardscape details; basic specifications; irrigation, lighting awareness; maintenance considerations; presentation techniques; professional practice overview.

Text Books

1. Booth, N. K., & Hiss, J. E. (2005). *Residential landscape architecture*. Pearson.
2. Reid, G. W. (2007). *Landscape graphics*. Watson-Guptill.
3. Laurie, M. (1986). *An introduction to landscape architecture*. Elsevier.
4. Motloch, J. L. (2001). *Introduction to landscape design*. Wiley.
5. Thompson, I. H. (2014). *Landscape architecture*. Routledge.

Reference Books

1. Simonds, J. O. (2006). *Landscape architecture*. McGraw-Hill.
2. Harris, C. W., & Dines, N. T. (1998). *Time-saver standards for landscape architecture*. McGraw-Hill.
3. McHarg, I. (1995). *Design with nature*. Wiley.
4. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

OPTION B: SET DESIGN

Course Objectives

1. To introduce fundamentals of set design.
2. To understand spatial storytelling and visual narrative.
3. To study set elements, materials, and construction.
4. To integrate lighting, color, and props.

5. To develop basic set design concepts.

Course Outcomes

- CO1: Identify principles of set design.
- CO2: Analyze scripts and visual requirements.
- CO3: Develop conceptual set layouts.
- CO4: Integrate materials, lighting, and props.
- CO5: Present basic set design proposals.

Detailed Syllabus

Unit I
Set design overview; scope; applications in theatre, film, television, exhibitions; relationship with interior design; role of set designer; design workflow; collaboration with directors, production teams.

Unit II
Script and concept analysis; narrative interpretation; mood, theme; spatial storytelling; scale, proportion; visual symbolism; audience perception; design translation from concept to space.

Unit III
Set elements; platforms, backdrops, flats; materials selection; temporary construction methods; structural safety awareness; surface treatments; textures, finishes; adaptability requirements.

Unit IV
Lighting and color in set design; mood creation; focus, emphasis; visual hierarchy; coordination with lighting designers; color palettes; scene transitions; spatial illusion techniques.

Unit V
Set drawings and presentation; plans, sections, elevations; model making basics; digital visualization awareness; budgeting basics; installation, dismantling considerations; professional practice overview.

Text Books

1. Rouse, J. (2013). *Theatre design*. Focal Press.
2. McKinney, J., & Butterworth, P. (2009). *The Cambridge introduction to scenography*. Cambridge University Press.
3. Aronson, A. (2005). *Looking into the abyss*. University of Michigan Press.
4. Gillette, J. M. (2010). *Theatrical design and production*. McGraw-Hill.
5. Howard, P. (2013). *What is scenography*. Routledge.

Reference Books

1. Baugh, C. (2013). *Theatre, performance and technology*. Palgrave Macmillan.
2. Mottram, J. (2009). *Theatrical design*. Routledge.
3. Porter, T. (2005). *Architectural drawing*. Architectural Press.
4. Ching, F. D. K. (2015). *Architectural graphics*. Wiley.
5. Lawson, B. (2005). *How designers think*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Interior Design Studio – II

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop intermediate studio design skills.
2. To apply theory knowledge to complex briefs.
3. To enhance design communication.
4. To integrate materials, furniture, and services.
5. To strengthen critique and presentation skills.

Course Outcomes

- CO1: Develop complete interior design proposals.
- CO2: Apply planning and detailing principles.
- CO3: Prepare drawings and presentations.
- CO4: Respond to critiques constructively.
- CO5: Demonstrate professional studio conduct.

List of Experiments / Exercises *(12 Exercises)*

1. Commercial interior design brief analysis and concept development using diagrams, zoning studies, and user requirement mapping.
2. Preparation of space planning layouts with circulation, furniture placement, and functional zoning for commercial interiors.

3. Development of material and finish palettes responding to design concept and functional requirements.
4. Lighting layout studies integrating ambient, task, and accent lighting for commercial spaces.
5. Interior elevation drawings showing wall treatments, finishes, and design details.
6. Furniture design integration within the commercial interior layout.
7. Service coordination drawings indicating HVAC, lighting, and basic plumbing interfaces.
8. Preparation of sectional drawings highlighting vertical relationships and detailing.
9. Three dimensional visualization through manual or digital means for design presentation.
10. Preparation of presentation boards including concept, drawings, and visuals.
11. Interim jury presentation and incorporation of critique feedback.
12. Final design presentation and documentation submission.

Expected Outcomes

Enhanced design integration skills; improved detailing capability; professional presentation competence; readiness for advanced studios.

Evaluation Scheme

Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To gain extended professional exposure.
2. To observe execution and coordination practices.
3. To understand industry workflows.
4. To document learning experiences.
5. To strengthen industry readiness.

Course Outcomes

- CO1: Observe professional interior practice.

- CO2: Identify construction and coordination methods.
- CO3: Follow workplace discipline.
- CO4: Maintain internship documentation.
- CO5: Reflect on professional learning.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER V

Smart Building Systems & Home Automation

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To introduce smart building concepts and automation systems.
2. To understand integration of technology with interior environments.
3. To study sensors, controls, and communication systems.
4. To apply automation strategies for comfort, safety, and efficiency.
5. To align interior design with intelligent building solutions.

Course Outcomes

- CO1: Identify components of smart building systems.
- CO2: Understand home automation principles.
- CO3: Integrate smart systems within interior layouts.
- CO4: Analyze user comfort and energy efficiency aspects.
- CO5: Apply basic automation concepts in design proposals.

Detailed Syllabus

Unit I
Smart buildings concepts; evolution; intelligent environments; building automation overview; system architecture; sensors, actuators; controllers; communication protocols; integration with interiors; performance objectives.

Unit II
Home automation systems; lighting control; shading systems; HVAC integration; user interfaces; wired, wireless technologies; control logic; interior coordination requirements.

Unit III
Security and safety systems; access control; CCTV; intrusion detection; fire alarm integration; monitoring systems; spatial placement; interior design considerations.

Unit IV
Energy management systems; smart meters; load management; renewable integration awareness; efficiency strategies; user behavior influence; sustainability alignment.

Unit V
System integration basics; interoperability; commissioning overview; maintenance

considerations; user training; future trends; smart living environments; design integration challenges.

Text Books

1. Clements-Croome, D. (2014). *Intelligent buildings*. ICE Publishing.
2. Sinopoli, J. (2010). *Smart building systems for architects*. Butterworth-Heinemann.
3. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
4. McQuiston, F. C., Parker, J. D., & Spitler, J. D. (2005). *HVAC analysis and design*. Wiley.
5. Harper, R. (2011). *Inside the smart home*. Springer.

Reference Books

1. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.
2. ASHRAE. (2017). *HVAC fundamentals*. ASHRAE.
3. Hall, F. (2010). *Building services and equipment*. Pearson.
4. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
5. Newman, P., & Jennings, I. (2008). *Cities as sustainable ecosystems*. Island Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Sustainable & Green Interior Design

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce sustainability concepts in interior design.
2. To understand environmental impact of materials and systems.
3. To apply green strategies in interior spaces.
4. To promote resource efficiency and user well being.
5. To align interiors with sustainability standards.

Course Outcomes

- CO1: Identify principles of sustainable interior design.
- CO2: Select environmentally responsible materials.

- CO3: Integrate passive design strategies.
- CO4: Analyze indoor environmental quality.
- CO5: Apply sustainability concepts in design proposals.

Detailed Syllabus

Unit I
Sustainability concepts; environmental impact; life cycle thinking; resource efficiency; climate responsive design; interior relevance; sustainability frameworks overview.

Unit II
Green materials; low VOC finishes; recycled materials; renewable resources; certification awareness; material selection criteria; interior applications.

Unit III
Energy efficient interiors; lighting strategies; daylight utilization; thermal comfort; equipment efficiency; user behavior influence.

Unit IV
Water efficiency; low flow fixtures; rainwater harvesting awareness; indoor water management; interior coordination aspects.

Unit V
Green rating systems overview; LEED, GRIHA awareness; documentation basics; sustainable interior strategies; professional responsibilities.

Text Books

1. Kang, M., & Guerin, D. A. (2009). *The state of environmentally sustainable interior design*. Journal of Interior Design.
2. Edwards, B. (2014). *Rough guide to sustainability*. RIBA Publishing.
3. Kwok, A. G., & Grondzik, W. T. (2011). *The green studio handbook*. Architectural Press.
4. Winchip, S. M. (2011). *Sustainable design for interior environments*. Fairchild.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. Vale, B., & Vale, R. (1991). *Green architecture*. Thames & Hudson.
2. McDonough, W., & Braungart, M. (2002). *Cradle to cradle*. North Point Press.
3. Kibert, C. (2016). *Sustainable construction*. Wiley.
4. Halliday, S. (2008). *Sustainable construction*. Butterworth-Heinemann.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Digital Visualization & 3D Modelling

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop digital visualization skills.
2. To understand three dimensional modelling principles.
3. To apply software tools for interior visualization.
4. To enhance design communication quality.
5. To support studio and professional presentations.

Course Outcomes

- CO1: Create basic three dimensional models.
- CO2: Apply materials, lighting, and textures digitally.
- CO3: Generate interior views and walkthroughs.
- CO4: Integrate digital models with design concepts.
- CO5: Present designs using visualization tools.

Detailed Syllabus

Unit I
Introduction to digital visualization; modelling concepts; coordinate systems; basic primitives; transformation tools; workflow overview; interior relevance.

Unit II
Three dimensional modelling techniques; walls, floors, ceilings; furniture modelling basics; accuracy; scale control; interior assemblies.

Unit III
Material and texture mapping; surface properties; finishes; lighting basics; rendering concepts; interior ambience creation.

Unit IV
Camera views; perspectives; walkthrough basics; composition; visual storytelling; presentation standards.

Unit V
Output and integration; rendering settings; file formats; post processing basics; integration with studio drawings; professional presentation.

Text Books

1. Dondis, D. A. (1973). *A primer of visual literacy*. MIT Press.
2. Ching, F. D. K., & Juroszek, S. P. (2010). *Design drawing*. Wiley.
3. Omura, G., & Benton, B. C. (2013). *Mastering AutoCAD and AutoCAD LT*. Wiley.
4. Kalay, Y. (2004). *Architecture's new media*. MIT Press.
5. Gill, P. S. (2012). *Engineering drawing*. Katson.

Reference Books

1. Porter, T. (2005). *Architectural drawing*. Architectural Press.
2. Yee, R. (2014). *Architectural drawing*. Wiley.
3. Madsen, D. (2016). *Engineering drawing and design*. Cengage.
4. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
5. Lawson, B. (2005). *How designers think*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Building Information Modelling (BIM)

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce BIM concepts and workflows.
2. To understand information based modelling for buildings.
3. To integrate interior elements within BIM environment.
4. To support coordination and documentation.
5. To align design practice with industry standards.

Course Outcomes

- CO1: Understand BIM principles and benefits.
- CO2: Create basic BIM models for interiors.

- CO3: Integrate components and data.
- CO4: Coordinate drawings and schedules.
- CO5: Apply BIM in interior documentation.

Detailed Syllabus

Unit I
BIM fundamentals; definition; evolution; differences from CAD; model based workflows; information integration; interior relevance.

Unit II
BIM modelling basics; walls, floors, ceilings; parametric components; families; interior assemblies; accuracy.

Unit III
Data integration; materials; quantities; schedules; coordination basics; clash awareness; documentation.

Unit IV
Collaboration concepts; multidisciplinary coordination; model sharing; version control; professional workflows.

Unit V
BIM applications; visualization; facility management awareness; industry standards; future trends; professional adoption.

Text Books

1. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). *BIM handbook*. Wiley.
2. Kymmell, W. (2008). *Building information modeling*. McGraw-Hill.
3. Hardin, B., & McCool, D. (2015). *BIM and construction management*. Wiley.
4. Krygiel, E., & Nies, B. (2008). *Green BIM*. Wiley.
5. Smith, D. K., & Tardif, M. (2009). *Building information modeling*. Wiley.

Reference Books

1. Succar, B. (2009). *Building information modelling framework*. Automation in Construction.
2. Azhar, S. (2011). *BIM for sustainable design*. Wiley.
3. Eastman, C. (2014). *BIM planning guide*. Penn State.
4. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
5. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Retail / Hospitality Interiors)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Option A: Retail Interiors

Course Objectives

1. To understand fundamentals of retail interior environments.
2. To study consumer behavior and spatial response.
3. To apply branding principles in retail spaces.
4. To integrate merchandising and interior planning.
5. To develop functional retail interior solutions.

Course Outcomes

- CO1: Identify retail interior typologies and requirements.
- CO2: Analyze consumer movement and behavior patterns.
- CO3: Apply retail planning and display principles.
- CO4: Integrate branding with interior environments.
- CO5: Develop basic retail interior design proposals.

Detailed Syllabus

Unit I
Retail interior design fundamentals; retail typologies, malls, boutiques, flagship stores; consumer behavior patterns; branding principles; spatial zoning, circulation planning; merchandise display strategies; visual hierarchy; customer experience parameters; functional performance criteria; regulatory awareness and lighting material selection integration.

Unit II
Hospitality interior design scope; hotels, resorts, restaurants, cafes; guest experience focus; functional zoning; front of house, back of house relationships; circulation logic; ambience creation; comfort parameters; service efficiency; brand identity expression through lighting, materials, finishes, furniture selection.

Unit III
Retail planning components; store layouts, grid, free flow, boutique planning; merchandise zoning; aisle widths; display heights; visual merchandising principles; lighting emphasis;

signage integration; checkout placement; accessibility; safety considerations; operational efficiency; customer navigation, wayfinding clarity, material durability.

Unit IV
Hospitality space planning; guest rooms; lobbies; restaurants; bars; public areas; furniture layouts; ergonomic comfort; lighting ambience; acoustic control; material durability; service coordination; hygiene standards; universal accessibility awareness; circulation efficiency, safety compliance, brand consistency objectives, user satisfaction focus.

Unit V
Professional documentation; retail, hospitality drawings; plans, sections, elevations; furniture layouts; lighting layouts; material specifications; coordination with services; statutory compliance; cost awareness; presentation techniques; client communication; project delivery framework, scheduling, detailing accuracy, quality control, professional accountability standards.

Text Books

1. Lawson, F. (2001). *Restaurants, clubs and bars*. Architectural Press.
2. Kent, T. (2012). *Retail branding*. Palgrave Macmillan.
3. Pile, J. (2013). *Interior design*. Pearson.
4. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Reference Books

1. Gibbs, J. (2011). *Interior design for retail spaces*. Images Publishing.
2. Barr, V. (2005). *Retail design*. Laurence King.
3. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
4. Porter, T. (2004). *Color planning for interiors*. Architectural Press.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

OPTION B: HOSPITALITY INTERIORS

Course Objectives

1. To understand hospitality interior typologies and operational requirements.
2. To analyze guest experience and spatial behavior.

3. To integrate branding, ambience, and functionality.
4. To apply materials, lighting, and furniture for hospitality use.
5. To develop comprehensive hospitality interior design solutions.

Course Outcomes

- CO1: Identify functional and experiential requirements of hospitality interiors.
- CO2: Analyze spatial planning for hospitality facilities.
- CO3: Apply design principles to guest oriented environments.
- CO4: Integrate services, materials, and furniture appropriately.
- CO5: Prepare basic hospitality interior design proposals.

Detailed Syllabus

Unit I
Hospitality interiors overview; hotels, resorts, restaurants, cafes; hospitality industry structure; guest expectations; service oriented environments; functional objectives; ambience creation; brand positioning; operational efficiency; interior designer role; coordination with management requirements.

Unit II
Hospitality space planning principles; front of house, back of house zoning; circulation patterns; guest flow; staff movement; privacy gradients; spatial hierarchy; functional adjacency; accessibility requirements; safety considerations; interior planning efficiency parameters.

Unit III
Guest room interiors; room typologies; layout planning; furniture selection; ergonomic comfort; storage solutions; lighting ambience; material durability; acoustic comfort; service integration; user comfort optimization; maintenance awareness; brand consistency considerations.

Unit IV
Public area interiors; lobbies, lounges, restaurants, banquet halls; seating layouts; spatial scale; lighting design; acoustics control; material selection; finishes; visual identity; experiential design; comfort parameters; operational coordination; hygiene and safety awareness.

Unit V
Hospitality interior documentation; plans, sections, elevations; furniture layouts; lighting layouts; material specifications; coordination with HVAC, plumbing, fire systems; statutory compliance; cost awareness; presentation standards; project execution overview; professional responsibility framework.

Text Books

1. Lawson, F. (2001). *Hotels and resorts: Planning and design*. Architectural Press.
2. Rutes, W. A., Penner, R. H., & Adams, L. (2001). *Hotel design, planning, and development*. Architectural Press.
3. Pile, J. (2013). *Interior design*. Pearson.
4. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Reference Books

1. Penner, R. H., Adams, L., & Rutes, W. A. (2013). *Hotel design, planning, and development*. W. W. Norton.
2. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
3. Porter, T. (2004). *Color planning for interiors*. Architectural Press.
4. Ching, F. D. K., & Binggeli, C. (2018). *Interior design illustrated*. Wiley.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Project (Interior Design Proposal)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To apply accumulated knowledge in a design project.
2. To develop research based interior proposals.
3. To integrate planning, materials, and services.
4. To enhance documentation and presentation skills.
5. To prepare students for advanced project work.

Course Outcomes

- CO1: Develop comprehensive interior design proposals.
- CO2: Apply analytical and creative skills.
- CO3: Prepare drawings and documentation.

- CO4: Present and defend design concepts.
- CO5: Demonstrate professional design approach.

Guidelines

Project brief definition; site analysis; concept development; design drawings; material selection; presentation; review and evaluation.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER VI

Intelligent Lighting & Energy Management Systems

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand intelligent lighting systems and controls.
2. To study energy management strategies in buildings.
3. To integrate lighting automation with interior design.
4. To enhance visual comfort and energy efficiency.
5. To support smart and sustainable interior solutions.

Course Outcomes

- CO1: Identify intelligent lighting system components.
- CO2: Apply lighting control strategies.
- CO3: Analyze energy consumption patterns.
- CO4: Integrate lighting systems with interiors.
- CO5: Evaluate energy efficient lighting solutions.

Detailed Syllabus

Unit I
Lighting fundamentals; luminous flux, intensity, illuminance; visual comfort parameters; glare control; lighting quality; interior relevance; standards overview; energy considerations.

Unit II
Artificial lighting systems; lamps, luminaires; LED technology; efficiency parameters; color temperature; color rendering; interior application criteria.

Unit III
Lighting control systems; sensors; occupancy, daylight sensors; dimming systems; control protocols; user interfaces; interior integration.

Unit IV
Energy management systems; monitoring; metering; load profiling; demand control; integration with lighting; efficiency optimization.

Unit V
Smart lighting applications; automated scenes; building integration; commissioning basics; maintenance considerations; future trends; professional practice awareness.

Text Books

1. Steffy, G. (2013). *Architectural lighting design*. Wiley.
2. DiLaura, D., Houser, K., Mistrick, R., & Steffy, G. (2011). *The lighting handbook*. IESNA.
3. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
4. Boyce, P. (2014). *Human factors in lighting*. CRC Press.
5. Rangwala, S. C. (2014). *Building services*. Charotar Publishing.

Reference Books

1. Hall, F. (2010). *Building services and equipment*. Pearson.
2. ASHRAE. (2017). *HVAC fundamentals*. ASHRAE.
3. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
4. Clements-Croome, D. (2014). *Intelligent buildings*. ICE Publishing.
5. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Interior Services Integration & Controls

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand integration of interior services.
2. To coordinate lighting, HVAC, and automation systems.
3. To develop control strategies for interior environments.
4. To support efficient and safe service layouts.
5. To enhance multidisciplinary coordination skills.

Course Outcomes

- CO1: Identify interior service systems.
- CO2: Integrate multiple services coherently.
- CO3: Apply control concepts in interiors.
- CO4: Analyze coordination challenges.

- CO5: Interpret integrated service drawings.

Detailed Syllabus

Unit I
Interior services overview; lighting, HVAC, plumbing, fire systems; coordination principles; spatial planning interface; integration challenges.

Unit II
Control systems basics; centralized, distributed controls; sensors; actuators; communication basics; interior relevance.

Unit III
Service coordination methods; reflected ceiling plans; service zoning; clash avoidance; documentation practices.

Unit IV
Automation integration; building management systems; monitoring; control logic; user interaction; interior impact.

Unit V
Maintenance and operation considerations; access requirements; safety; commissioning overview; professional coordination responsibilities.

Text Books

1. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
2. Clements-Croome, D. (2014). *Intelligent buildings*. ICE Publishing.
3. Rangwala, S. C. (2014). *Building services*. Charotar Publishing.
4. Hall, F. (2010). *Building services and equipment*. Pearson.
5. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.

Reference Books

1. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.
2. ASHRAE. (2017). *HVAC fundamentals*. ASHRAE.
3. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
4. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Universal Design & Accessibility

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce universal design principles.
2. To understand accessibility requirements.
3. To apply inclusive design strategies.
4. To align interiors with statutory guidelines.
5. To promote user centric design thinking.

Course Outcomes

- CO1: Identify universal design principles.
- CO2: Apply accessibility standards in interiors.
- CO3: Analyze user diversity needs.
- CO4: Integrate inclusive design features.
- CO5: Evaluate accessibility compliance.

Detailed Syllabus

Unit I
Universal design concepts; inclusive design philosophy; user diversity; physical, sensory, cognitive considerations; interior relevance.

Unit II
Accessibility standards overview; circulation widths; ramps; handrails; signage; interior applications.

Unit III
Accessible residential interiors; kitchens, bathrooms; furniture adaptation; safety considerations; comfort.

Unit IV
Public and commercial interiors; accessibility requirements; wayfinding; service counters; inclusive planning.

Unit V
Statutory guidelines; code awareness; audit basics; professional responsibility; ethical considerations; inclusive practice.

Text Books

1. Steinfeld, E., & Maisel, J. (2012). *Universal design*. Wiley.

2. Goldsmith, S. (2000). *Universal design*. Architectural Press.
3. Preiser, W., & Ostroff, E. (2001). *Universal design handbook*. McGraw-Hill.
4. Panero, J., & Zelnik, M. (2014). *Human dimension and interior space*. Watson-Guptill.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
2. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
3. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design*. Rockport.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (Smart Furniture / Exhibition Design)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

OPTION A: SMART FURNITURE

Course Objectives

1. To introduce concepts of smart and interactive furniture.
2. To integrate technology with furniture design.
3. To understand user centered and multifunctional furniture solutions.
4. To apply ergonomics and adaptability in smart furniture.
5. To develop awareness of emerging furniture technologies.

Course Outcomes

- CO1: Identify smart furniture concepts and applications.
- CO2: Integrate technology within furniture design.
- CO3: Apply ergonomic and functional principles.

- CO4: Analyze user interaction with smart furniture.
- CO5: Develop basic smart furniture design concepts.

Detailed Syllabus

Unit I
Smart furniture concepts; definition, scope; integration of technology with furniture; sensors, actuators, embedded systems; multifunctional furniture; space efficiency; ergonomics; user interaction; residential, commercial applications; sustainability considerations; contemporary trends; design adaptability, material innovation, digital fabrication awareness, lifecycle performance, customization potential.

Unit II
Technology components in furniture; IoT basics; connectivity concepts; power supply options; wired, wireless controls; interfaces; automation logic; safety considerations; reliability; maintenance awareness; integration constraints; interior compatibility requirements; cost implications; scalability aspects; usability factors.

Unit III
Ergonomics and human factors; anthropometric data application; adjustable furniture systems; posture support; comfort optimization; inclusive design considerations; accessibility; safety norms; usability testing; interaction feedback; user experience mapping; functional validation parameters; adaptability across user groups.

Unit IV
Materials and construction for smart furniture; engineered wood; metals; composites; smart materials awareness; joinery integration; concealment of components; durability; thermal management; maintenance access; sustainability aspects; recyclability; manufacturing constraints; quality control parameters.

Unit V
Design documentation and presentation; smart furniture drawings; exploded views; wiring layouts; specification basics; prototyping awareness; testing procedures; installation considerations; professional practice overview; intellectual property awareness; market trends; innovation opportunities; future development directions.

Text Books

1. Harper, R. (2011). *Inside the smart home*. Springer.
2. Panero, J., & Zelnik, M. (2014). *Human dimension and interior space*. Watson-Guptill.
3. Ashby, M., & Johnson, K. (2010). *Materials and design*. Butterworth-Heinemann.
4. Green, W. (2006). *Furniture design*. Laurence King.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. Dormer, P. (1993). *The culture of craft*. Manchester University Press.
2. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.
3. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
4. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design*. Rockport.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

OPTION B: EXHIBITION DESIGN

Course Objectives

1. To introduce fundamentals of exhibition and display design.
2. To understand spatial storytelling and visitor experience.
3. To integrate graphics, lighting, and interactive elements.
4. To apply temporary structure and material strategies.
5. To develop exhibition design concepts and layouts.

Course Outcomes

- CO1: Identify exhibition design typologies and objectives.
- CO2: Analyze visitor movement and engagement patterns.
- CO3: Apply spatial and visual communication strategies.
- CO4: Integrate displays, lighting, and graphics.
- CO5: Develop basic exhibition design proposals.

Detailed Syllabus

Unit I
Exhibition design overview; museums, trade fairs, galleries; purpose and objectives; narrative development; audience profiling; spatial sequencing; interpretive strategies; experiential design; cultural, commercial contexts; communication goals; temporary architecture relevance; professional roles and responsibilities.

Unit II
Exhibition space planning; zoning; circulation paths; entry, exit sequencing; visitor flow

management; accessibility considerations; safety norms; crowd behavior; functional adjacencies; scale, proportion; spatial hierarchy; flexibility requirements; operational efficiency parameters.

Unit III
Display systems; panels, showcases, plinths; modular systems; materials selection; structural safety awareness; finishes; durability; reusability; sustainability considerations; detailing basics; integration with content; visual emphasis; maintenance aspects.

Unit IV
Lighting and graphics integration; accent lighting; focus creation; glare control; graphic panels; typography; wayfinding; audiovisual elements awareness; interactive media basics; visitor engagement strategies; multisensory experience; coherence in visual language.

Unit V
Exhibition documentation; layout plans; sections; elevations; display details; material specifications; installation sequencing; dismantling considerations; cost awareness; presentation techniques; coordination with fabricators; professional practice overview; project execution framework.

Text Books

1. Lorenc, J., Skolnick, L., & Berger, C. (2007). *What is exhibition design*. RotoVision.
2. McLean, K. (1999). *Planning for people in museum exhibitions*. Association of Science-Technology Centers.
3. Porter, T. (2005). *Architectural drawing*. Architectural Press.
4. Ching, F. D. K. (2015). *Architectural graphics*. Wiley.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. Bogle, E. (2013). *Designing exhibitions*. Routledge.
2. Bitgood, S. (2010). *Social design in museums*. Left Coast Press.
3. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Practice & Project Management

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce professional practice frameworks.
2. To understand project management principles.
3. To develop coordination and documentation skills.
4. To align practice with industry standards.
5. To prepare for professional roles.

Course Outcomes

- CO1: Understand professional practice structures.
- CO2: Apply basic project management concepts.
- CO3: Prepare professional documentation.
- CO4: Analyze project workflows.
- CO5: Demonstrate professional awareness.

Detailed Syllabus

Unit I
Professional practice overview; roles; ethics; scope of services; client relationships; regulatory awareness.

Unit II
Project management basics; project lifecycle; planning; scheduling; coordination; interior relevance.

Unit III
Cost management basics; estimates; budgets; billing methods; financial awareness.

Unit IV
Contracts and documentation; drawings; specifications; tendering basics; professional communication.

Unit V
Site coordination; quality control; timelines; risk awareness; professional responsibilities.

Text Books

1. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
2. Kerzner, H. (2017). *Project management*. Wiley.

3. Chitkara, K. K. (2014). *Construction project management*. Tata McGraw-Hill.
4. Walker, A. (2015). *Project management in construction*. Wiley Blackwell.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. PMBOK. (2017). *Project management body of knowledge*. PMI.
2. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
3. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project II (Smart Interior Prototype)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To develop a smart interior prototype.
2. To integrate design and technology concepts.
3. To apply research and innovation.
4. To enhance documentation and presentation.
5. To prepare for major project execution.

Course Outcomes

- CO1: Design smart interior solutions.
- CO2: Integrate systems and interiors.
- CO3: Develop prototype documentation.
- CO4: Present project outcomes.
- CO5: Demonstrate applied learning.

Guidelines

Problem identification; concept development; system integration; drawings; prototype development; review; evaluation.

Evaluation Scheme

Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To gain advanced industry exposure.
2. To observe smart system applications.
3. To understand professional coordination.
4. To document field experience.
5. To strengthen employability readiness.

Course Outcomes

- CO1: Observe smart interior implementations.
- CO2: Identify system coordination practices.
- CO3: Follow professional discipline.
- CO4: Maintain internship records.
- CO5: Reflect on industry learning.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER VII

Advanced Interior Design Studio

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To develop advanced interior design capabilities.
2. To handle complex design briefs and contexts.
3. To integrate systems, sustainability, and technology.
4. To strengthen professional documentation skills.
5. To prepare students for industry level practice.

Course Outcomes

- CO1: Develop comprehensive advanced interior proposals.
- CO2: Integrate services, materials, and smart systems.
- CO3: Prepare professional drawings and presentations.
- CO4: Respond critically to design reviews.
- CO5: Demonstrate independent design thinking.

List of Experiments / Exercises *(12 Exercises)*

1. Advanced design brief analysis including site context, user profiling, regulatory constraints, and functional objectives.
2. Concept development using research based themes, narratives, and spatial strategies aligned with project requirements.
3. Preparation of detailed space planning layouts with zoning, circulation, and functional optimization.
4. Integration of smart systems and sustainability strategies within the interior design proposal.
5. Development of material, finish, and furniture specifications responding to performance and aesthetics.
6. Lighting design integration including ambient, task, accent, and intelligent control strategies.
7. Preparation of interior construction details and coordination drawings.

8. Three dimensional visualization and presentation development using appropriate digital tools.
9. Preparation of complete drawing set including plans, sections, elevations, and schedules.
10. Interim jury presentation and incorporation of structured critique feedback.
11. Final design presentation with comprehensive documentation and rationale.
12. Portfolio compilation and reflection on advanced studio learning outcomes.

Expected Outcomes

Advanced design competence; professional level documentation; integrated system thinking; readiness for major project execution.

Evaluation Scheme

Continuous Assessment (100%)

Interior Systems Integration & IoT Applications

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce IoT applications in interior environments.
2. To understand system integration using connected devices.
3. To apply data driven control strategies.
4. To enhance intelligent interior functionality.
5. To align interiors with emerging technologies.

Course Outcomes

- CO1: Identify IoT components used in interiors.
- CO2: Understand data communication and control concepts.
- CO3: Integrate IoT systems within interior layouts.
- CO4: Analyze smart interior use cases.
- CO5: Apply IoT concepts in design solutions.

Detailed Syllabus

Unit I
Internet of Things concepts; sensors, actuators; connectivity; data flow; smart environments; interior relevance; system overview.

Unit II
IoT hardware components; microcontrollers basics; communication protocols; wired, wireless networks; interior applications.

Unit III
Smart interior applications; lighting control; climate control; security; monitoring systems; user interaction interfaces.

Unit IV
Data management basics; automation logic; dashboards; control strategies; performance monitoring; interior integration.

Unit V
Challenges and future trends; interoperability; cybersecurity awareness; scalability; professional practice considerations.

Text Books

1. Bahga, A., & Madisetti, V. (2014). *Internet of Things*. VPT.
2. Clements-Croome, D. (2014). *Intelligent buildings*. ICE Publishing.
3. Wang, S. (2010). *Intelligent buildings and building automation*. Taylor & Francis.
4. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
5. Harper, R. (2011). *Inside the smart home*. Springer.

Reference Books

1. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). *Internet of Things*. Elsevier.
2. ASHRAE. (2017). *HVAC fundamentals*. ASHRAE.
3. Hall, F. (2010). *Building services and equipment*. Pearson.
4. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
5. Newman, P., & Jennings, I. (2008). *Cities as sustainable ecosystems*. Island Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Building Codes, Regulations & Safety

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand building codes and regulatory frameworks.
2. To apply safety norms in interior design.
3. To develop compliance awareness.
4. To integrate statutory requirements in design.
5. To promote safe interior environments.

Course Outcomes

- CO1: Identify applicable building regulations.
- CO2: Apply safety standards in interiors.
- CO3: Interpret code provisions.
- CO4: Integrate compliance in design documentation.
- CO5: Demonstrate professional responsibility.

Detailed Syllabus

Unit I
Building regulations overview; statutory authorities; approval processes; interior design relevance; compliance framework.

Unit II
Fire safety regulations; exits; staircases; materials; detection systems; interior planning implications.

Unit III
Structural safety awareness; load considerations; non structural elements; fixing methods; interior coordination.

Unit IV
Health and safety norms; lighting, ventilation; indoor environmental quality; user safety.

Unit V
Accessibility and inclusivity codes; barrier free norms; professional liability; ethical practice.

Text Books

1. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
2. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.

3. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.
4. Hall, F. (2010). *Building services and equipment*. Pearson.
5. Rangwala, S. C. (2014). *Building services*. Charotar Publishing.

Reference Books

1. Everett, A., & Barritt, C. (2011). *Materials*. Pearson.
2. Greeno, R., & Hall, F. (2017). *Building services handbook*. Routledge.
3. ASHRAE. (2017). *HVAC fundamentals*. ASHRAE.
4. Lawson, B. (2005). *How designers think*. Architectural Press.
5. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Course 4: Professional Elective II (Healthcare / Institutional Interiors)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

OPTION A: HEALTHCARE INTERIORS

Course Objectives

1. To understand functional requirements of healthcare interiors.
2. To study patient centered and evidence based design principles.
3. To integrate hygiene, safety, and regulatory considerations.
4. To apply ergonomic and operational planning in healthcare spaces.
5. To develop responsive healthcare interior design solutions.

Course Outcomes

- CO1: Identify healthcare interior typologies and requirements.
- CO2: Apply patient centered planning principles.
- CO3: Integrate safety, hygiene, and accessibility norms.
- CO4: Coordinate services and materials in healthcare settings.
- CO5: Prepare basic healthcare interior design proposals.

Detailed Syllabus

Unit I
Healthcare interiors overview; hospitals, clinics, diagnostic centers; healthcare delivery systems; patient, staff, visitor requirements; functional zoning; healing environments; operational efficiency; interior designer role; regulatory awareness; safety priorities; infection control relevance.

Unit II
Healthcare space planning principles; outpatient, inpatient zones; circulation separation; patient flow; staff movement; privacy gradients; accessibility norms; wayfinding; safety considerations; spatial hierarchy; efficiency parameters; compliance driven planning requirements.

Unit III
Patient care spaces; wards, ICUs, operation theatres awareness; furniture selection; ergonomic comfort; medical equipment interface; lighting requirements; acoustic control; material durability; hygiene surfaces; maintenance considerations; user comfort optimization.

Unit IV
Public and support spaces; reception, waiting areas; nursing stations; diagnostic rooms; service zones; material selection; finishes; lighting ambience; acoustic comfort; infection control measures; operational coordination; safety compliance.

Unit V
Healthcare documentation; layout drawings; furniture layouts; finish schedules; coordination with HVAC, plumbing, medical gas, fire systems; statutory compliance; cost awareness; presentation standards; execution overview; professional responsibility and ethical considerations.

Text Books

1. Verderber, S., & Fine, D. J. (2000). *Healthcare architecture in an era of radical transformation*. Yale University Press.
2. Stall, E. (2012). *Designing for health and human services*. Wiley.
3. Pile, J. (2013). *Interior design*. Pearson.
4. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Reference Books

1. Ulrich, R. et al. (2008). *A review of the research literature on evidence-based healthcare design*. The Center for Health Design.
2. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
3. Porter, T. (2004). *Color planning for interiors*. Architectural Press.

4. Ching, F. D. K., & Binggeli, C. (2018). *Interior design illustrated*. Wiley.
5. BIS. (2016). *National building code of India*. Bureau of Indian Standards.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

OPTION B: INSTITUTIONAL INTERIORS

Course Objectives

1. To understand interior planning for institutional buildings.
2. To study functional and behavioral requirements of institutions.
3. To integrate safety, accessibility, and durability considerations.
4. To apply systematic planning and detailing approaches.
5. To develop effective institutional interior design solutions.

Course Outcomes

- CO1: Identify institutional interior typologies and needs.
- CO2: Apply functional planning principles in institutions.
- CO3: Integrate regulatory and safety requirements.
- CO4: Coordinate materials, furniture, and services.
- CO5: Prepare basic institutional interior design proposals.

Detailed Syllabus

Unit I
Institutional interiors overview; educational, administrative, cultural institutions; functional objectives; user groups; operational requirements; spatial zoning; circulation planning; interior designer role; durability and safety priorities; regulatory awareness.

Unit II
Institutional space planning; classrooms, offices, auditoria, libraries; user capacity; circulation hierarchy; accessibility; safety norms; acoustic requirements; lighting needs; functional adjacency; efficiency optimization parameters.

Unit III
Learning and work spaces; furniture layouts; ergonomic considerations; flexibility; modular systems; material durability; lighting comfort; acoustic control; technology integration awareness; user productivity support.

Unit IV
Public and support spaces; corridors, lobbies, common areas; wayfinding systems; finishes selection; maintenance considerations; safety features; inclusive design awareness; user comfort; institutional identity expression.

Unit V
Institutional documentation; plans, sections, elevations; furniture layouts; finish schedules; service coordination; statutory compliance; cost awareness; presentation standards; execution overview; professional accountability and ethical responsibilities.

Text Books

1. De Chiara, J., Panero, J., & Zelnik, M. (2001). *Time-saver standards for building types*. McGraw-Hill.
2. Neufert, E. (2012). *Architects' data*. Wiley Blackwell.
3. Pile, J. (2013). *Interior design*. Pearson.
4. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Reference Books

1. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
2. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
3. Lawson, B. (2005). *How designers think*. Architectural Press.
4. Blakemore, R. G. (2014). *History of interior design and furniture*. Wiley.
5. Barry, R. (2018). *The construction of buildings*. Wiley Blackwell.

Evaluation Scheme

Continuous Assessment (40%) + End-Semester Examination (60%)

Entrepreneurship & Interior Design Practice

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce entrepreneurship concepts.
2. To understand interior design business models.
3. To develop entrepreneurial mindset.
4. To address legal and financial aspects.

5. To prepare for independent professional practice.

Course Outcomes

- CO1: Understand entrepreneurship fundamentals.
- CO2: Analyze interior design business opportunities.
- CO3: Prepare basic business plans.
- CO4: Understand legal and financial requirements.
- CO5: Demonstrate entrepreneurial awareness.

Detailed Syllabus

Unit I
Entrepreneurship concepts; innovation; opportunity identification; interior design industry overview.

Unit II
Business models; design firms; consultancy structures; services; value proposition.

Unit III
Legal aspects; registrations; contracts; intellectual property; professional ethics.

Unit IV
Financial basics; costing; pricing; cash flow; taxation awareness.

Unit V
Marketing and branding; client acquisition; portfolio development; digital presence.

Text Books

1. Kuratko, D. F. (2016). *Entrepreneurship*. Cengage.
2. Timmons, J. A., & Spinelli, S. (2009). *New venture creation*. McGraw-Hill.
3. Hisrich, R., Peters, M., & Shepherd, D. (2017). *Entrepreneurship*. McGraw-Hill.
4. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
5. Chitkara, K. K. (2014). *Construction project management*. Tata McGraw-Hill.

Reference Books

1. Drucker, P. (2014). *Innovation and entrepreneurship*. Routledge.
2. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
3. Kerzner, H. (2017). *Project management*. Wiley.
4. Walker, A. (2015). *Project management in construction*. Wiley Blackwell.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship (Industry / Design Firm)

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To gain in depth industry exposure.
2. To participate in professional design activities.
3. To understand project execution workflows.
4. To develop professional conduct.
5. To strengthen employability skills.

Course Outcomes

- CO1: Participate in professional interior design work.
- CO2: Observe coordination and execution processes.
- CO3: Demonstrate workplace discipline.
- CO4: Maintain detailed internship documentation.
- CO5: Reflect on professional competencies.

Evaluation Scheme

Continuous Assessment (100%)

Major Project Phase I

Course Category: Project Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To identify major project problem statement.
2. To conduct preliminary research and analysis.
3. To define scope and objectives.
4. To prepare project proposal and methodology.
5. To plan major project execution.

Course Outcomes

- CO1: Define major project theme and scope.
- CO2: Conduct background research.
- CO3: Prepare project proposal documentation.
- CO4: Present research findings.
- CO5: Plan systematic project execution.

Guidelines

Problem identification; literature review; case studies; project proposal; methodology definition; review and approval.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER VIII

Interior Design Management & Consultancy

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand interior design management principles.
2. To develop consultancy oriented professional skills.
3. To address client handling and project coordination.
4. To integrate design, business, and legal considerations.
5. To prepare for leadership roles in interior practice.

Course Outcomes

- CO1: Understand interior design management frameworks.
- CO2: Apply consultancy practices in professional scenarios.
- CO3: Manage client relationships and communication.
- CO4: Integrate financial and legal awareness in practice.
- CO5: Demonstrate leadership and decision making skills.

Detailed Syllabus

Unit I
Interior design management concepts; organizational structures; roles and responsibilities; workflow planning; coordination strategies; professional hierarchy; management functions; practice administration.

Unit II
Consultancy practice models; scope of services; fee structures; proposals; negotiations; client engagement strategies; professional ethics; contractual awareness.

Unit III
Human resource management; team structures; multidisciplinary coordination; leadership styles; communication management; performance evaluation; office operations.

Unit IV
Financial management basics; budgeting; cost control; billing practices; taxation awareness; risk management; financial decision making; sustainability of practice.

Unit V
Quality management; documentation standards; dispute resolution; professional liability; branding strategies; business development; future practice trends.

Text Books

1. Piotrowski, C. M. (2014). *Professional practice for interior designers*. Wiley.
2. Kerzner, H. (2017). *Project management*. Wiley.
3. Walker, A. (2015). *Project management in construction*. Wiley Blackwell.
4. Chitkara, K. K. (2014). *Construction project management*. Tata McGraw-Hill.
5. Pile, J. (2013). *Interior design*. Pearson.

Reference Books

1. PMBOK. (2017). *Project management body of knowledge*. PMI.
2. Drucker, P. (2014). *Innovation and entrepreneurship*. Routledge.
3. BIS. (2016). *National building code of India*. Bureau of Indian Standards.
4. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.
5. Lawson, B. (2005). *How designers think*. Architectural Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project Phase II (Industry / Live Project Based)

Course Category: Project Course
Credits / Contact Hours: 10 Credits / 150 Contact Hours

Course Objectives

1. To execute a comprehensive major interior design project.
2. To integrate research, design, and professional practice.
3. To demonstrate technical, creative, and managerial competence.
4. To address real world or industry based design problems.
5. To present professional quality documentation and outcomes.

Course Outcomes

- CO1: Execute a complete interior design project independently.
- CO2: Integrate smart systems and sustainability.

- CO3: Prepare professional drawings and reports.
- CO4: Present and defend project outcomes.
- CO5: Demonstrate readiness for professional practice.

Guidelines

Project execution; site analysis; design development; system integration; drawings; specifications; industry interaction; periodic reviews; final submission; viva voce.

Evaluation Scheme

Continuous Assessment (100%)

Open Elective III (Interdisciplinary)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To expose learners to interdisciplinary knowledge domains.
2. To broaden design perspectives beyond core interior discipline.
3. To integrate cross domain concepts into interior applications.
4. To develop analytical and contextual understanding.
5. To support innovation through interdisciplinary learning.

Course Outcomes

- CO1: Identify key concepts from selected interdisciplinary domain.
- CO2: Relate interdisciplinary knowledge to interior design contexts.
- CO3: Analyze problems using cross disciplinary perspectives.
- CO4: Integrate concepts into design thinking and solutions.
- CO5: Demonstrate adaptability to emerging knowledge areas.

Detailed Syllabus

Unit I
Interdisciplinary studies overview; definition; relevance to design education; integration of art, technology, management, sociology; systems thinking; design convergence; collaborative frameworks; interior design linkage.

Unit II
Design and technology interface; digital transformation; data driven environments; smart

systems influence; human centered technology; interdisciplinary innovation models; interior relevance.

Unit III
Design and sustainability integration; environmental science interface; social responsibility; ethical considerations; community oriented design; policy awareness; interdisciplinary impact on interiors.

Unit IV
Design and management linkage; economics basics; project coordination; decision making; organizational behavior; leadership perspectives; interdisciplinary professional practice.

Unit V
Future interdisciplinary domains; artificial intelligence awareness; digital fabrication; smart materials; emerging practices; lifelong learning orientation; adaptability in interior profession.

Text Books

1. Brown, T. (2009). *Change by design*. HarperCollins.
2. Lawson, B. (2005). *How designers think* (4th ed.). Architectural Press.
3. Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design* (2nd ed.). Rockport.
4. Cross, N. (2011). *Design thinking*. Berg.
5. Brooker, G., & Stone, S. (2010). *What is interior design*. RotoVision.

Reference Books

1. Buchanan, R. (1992). *Wicked problems in design thinking*. Design Issues.
2. Norman, D. (2013). *The design of everyday things*. Basic Books.
3. Kelley, T., & Kelley, D. (2013). *Creative confidence*. Crown Business.
4. Manzini, E. (2015). *Design, when everybody designs*. MIT Press.
5. Verganti, R. (2009). *Design driven innovation*. Harvard Business Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Seminar / Viva-Voce / Portfolio Review

Course Category: Project Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop research presentation skills.
2. To enhance critical analysis and articulation.
3. To review and consolidate learning outcomes.
4. To prepare professional portfolio documentation.
5. To assess overall programme competencies.

Course Outcomes

- CO1: Present seminar topics with clarity and structure.
- CO2: Demonstrate analytical and communication skills.
- CO3: Compile professional quality design portfolio.
- CO4: Respond effectively during viva voce examination.
- CO5: Reflect on overall academic and professional growth.

Guidelines

Topic selection; literature review; seminar presentation; portfolio compilation; viva voce examination; faculty and external evaluation.

Evaluation Scheme

Seminar Presentation (30%) + Portfolio Review (40%) + Viva-Voce (30%)

B.A. – Yoga & Life Sciences

Duration: 3 Years | 6 SEMESTER s | Total Credits: 120

SEMESTER I

Introduction to Yoga & Indian Knowledge Systems

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To develop foundational understanding of Yoga as a holistic discipline
2. To introduce Indian Knowledge Systems and civilizational frameworks
3. To familiarize philosophical bases of Yoga traditions
4. To integrate Yogic worldview with contemporary life sciences
5. To cultivate ethical and value-based perspectives

Course Outcomes

CO1: Understand foundations of Yoga and Indian Knowledge traditions
CO2: Interpret Yogic concepts within philosophical frameworks
CO3: Relate Indian Knowledge Systems to holistic health
CO4: Apply ethical principles derived from Yogic philosophy
CO5: Integrate traditional knowledge with modern contexts

Detailed Syllabus

Unit I
Meaning of Yoga, origin and evolution; definitions from classical sources; scope and relevance; Yoga as discipline and science; relationship between Yoga, culture, civilization; holistic health perspectives; physical, mental, spiritual dimensions; contemporary relevance; interdisciplinary integration.

Unit II
Indian Knowledge Systems, Vedic heritage; Shruti and Smriti traditions; six orthodox philosophies; concept of Purushartha; Dharma, Artha, Kama, Moksha; cosmology and epistemology; knowledge transmission methods; Gurukula system; oral traditions; integrative worldview.

Unit III
Concepts of mind and consciousness; Chitta, Manas, Buddhi, Ahamkara; Triguna theory;

Panchakosha model; Prakriti and Purusha; karma and samskara; self-regulation principles; psychological balance; behavioral harmonization.

Unit IV
Ethical foundations; Yama and Niyama principles; social responsibility; personal discipline; moral values; Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha; Saucha, Santosha, Tapas, Svadhyaya, Ishvara Pranidhana; societal harmony.

Unit V
Yoga in contemporary society; education, health, lifestyle applications; Yoga as preventive science; integration with modern medicine; global perspectives; institutional frameworks; research orientation; policy relevance; sustainable living; wellness promotion strategies.

Text Books

1. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
2. Saraswati, S. S. (2012). *Four Chapters on Freedom*. Yoga Publications Trust.
3. Radhakrishnan, S. (2008). *Indian Philosophy*. Oxford University Press.
4. Taimni, I. K. (2015). *The Science of Yoga*. Theosophical Publishing House.
5. Mishra, K. (2014). *Indian Knowledge Systems*. Pearson Education.

Reference Books

1. Vivekananda, S. (2010). *Raja Yoga*. Advaita Ashrama.
2. Dasgupta, S. (2009). *A History of Indian Philosophy*. Cambridge University Press.
3. Sharma, C. (2011). *Critical Survey of Indian Philosophy*. Motilal Banarsidass.
4. Chatterjee, S., & Datta, D. (2012). *An Introduction to Indian Philosophy*. University of Calcutta.
5. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Human Anatomy & Physiology – I

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand structural organization of human body
2. To study cellular and tissue-level anatomy

3. To analyze skeletal and muscular systems
4. To correlate anatomy with Yogic practices
5. To build foundation for applied physiology

Course Outcomes

CO1: Describe anatomical organization of human body
CO2: Identify cellular and tissue structures
CO3: Explain skeletal and muscular system functions
CO4: Relate anatomy to movement and posture
CO5: Apply anatomical knowledge in Yoga practice

Detailed Syllabus

Unit I
Introduction to anatomy and physiology; levels of organization; anatomical terminology; body planes and sections; homeostasis concept; cellular structure; cell membrane transport; organelle functions; metabolic regulation; physiological integration.

Unit II
Tissues of the body; epithelial tissue types; connective tissue classification; bone, cartilage, blood; muscular tissue varieties; nervous tissue characteristics; tissue repair; regeneration mechanisms; functional correlations; structural adaptations.

Unit III
Skeletal system overview; bone composition; axial and appendicular skeleton; joints classification; synovial joints; movements and stability; posture alignment; skeletal growth; calcium metabolism; biomechanical relevance.

Unit IV
Muscular system; muscle fiber structure; skeletal muscle anatomy; smooth and cardiac muscles; neuromuscular junction; muscle contraction mechanism; tone and fatigue; posture maintenance; movement coordination; Yogic relevance.

Unit V
Introduction to nervous system; neuron structure; neuroglia; central and peripheral nervous systems; reflex arc; autonomic nervous system; neural control of movement; sensory-motor integration; balance and coordination.

Text Books

1. Tortora, G. J., & Derrickson, B. H. (2021). *Principles of Anatomy and Physiology*. Wiley.
2. Ross, M. H., & Pawlina, W. (2019). *Histology*. Wolters Kluwer.
3. Guyton, A. C., & Hall, J. E. (2020). *Textbook of Medical Physiology*. Elsevier.
4. Marieb, E. N., & Hoehn, K. (2018). *Human Anatomy & Physiology*. Pearson.

5. Chaurasia, B. D. (2014). *Human Anatomy*. CBS Publishers.

Reference Books

1. Moore, K. L., Dalley, A. F., & Agur, A. M. (2019). *Clinically Oriented Anatomy*. Wolters Kluwer.
2. Standring, S. (2020). *Gray's Anatomy*. Elsevier.
3. Ganong, W. F. (2018). *Review of Medical Physiology*. McGraw-Hill.
4. Snell, R. S. (2017). *Clinical Anatomy*. Wolters Kluwer.
5. Widmaier, E. P., Raff, H., & Strang, K. T. (2019). *Vander's Human Physiology*. McGraw-Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Foundations of Life Sciences

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To introduce fundamental principles of life sciences
2. To understand cellular and molecular basis of life
3. To explain biological organization and diversity
4. To relate life science principles with health sciences
5. To build interdisciplinary scientific foundation

Course Outcomes

CO1: Understand basic concepts of life sciences
CO2: Explain cellular and molecular organization
CO3: Classify biological systems and diversity
CO4: Relate life processes with human health
CO5: Apply life science concepts in interdisciplinary contexts

Detailed Syllabus

Unit I
Nature and scope of life sciences; characteristics of living organisms; levels of biological organization; interdisciplinary linkages; scientific methods; observation and experimentation; hypothesis formulation; data interpretation; ethical considerations in biological research.

Unit II
Biomolecules; carbohydrates, lipids, proteins, nucleic acids; structure and functions; enzymes and catalysis; metabolism overview; anabolic and catabolic pathways; energy flow; ATP significance; metabolic regulation.

Unit III
Cell biology fundamentals; prokaryotic and eukaryotic cells; cell membrane structure; transport mechanisms; organelles and functions; cytoskeleton; cell cycle phases; mitosis and meiosis; cellular differentiation.

Unit IV
Genetics basics; DNA structure; replication mechanisms; RNA transcription; protein translation; genetic code; mutations; heredity principles; Mendelian laws; genotype and phenotype relationships; molecular inheritance patterns.

Unit V
Biological diversity; classification systems; domains and kingdoms; evolutionary concepts; natural selection; adaptation mechanisms; ecology basics; ecosystems and biomes; environmental interactions; conservation perspectives.

Text Books

1. Campbell, N. A., et al. (2021). *Biology*. Pearson.
2. Alberts, B., et al. (2022). *Molecular Biology of the Cell*. Garland Science.
3. Raven, P. H., Johnson, G. B., Mason, K. A., Losos, J. B., & Singer, S. R. (2020). *Biology*. McGraw-Hill.
4. Sadava, D., et al. (2019). *Life: The Science of Biology*. Sinauer.
5. Solomon, E. P., Berg, L. R., & Martin, D. W. (2018). *Biology*. Cengage.

Reference Books

1. Lodish, H., et al. (2021). *Molecular Cell Biology*. W.H. Freeman.
2. Pierce, B. A. (2020). *Genetics: A Conceptual Approach*. Macmillan.
3. Futuyma, D. J., & Kirkpatrick, M. (2017). *Evolution*. Sinauer.
4. Odum, E. P., & Barrett, G. W. (2018). *Fundamentals of Ecology*. Cengage.
5. Karp, G. (2019). *Cell and Molecular Biology*. Wiley.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yogic Texts – I (Yoga Sutras & Hatha Yoga Pradipika)

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To study foundational Yogic scriptures
2. To understand philosophical principles of Yoga Sutras
3. To analyze classical Hatha Yoga concepts
4. To interpret textual relevance in modern practice
5. To cultivate scriptural literacy

Course Outcomes

CO1: Interpret core teachings of Yoga Sutras
CO2: Explain concepts from Hatha Yoga Pradipika
CO3: Analyze philosophical foundations of Yoga
CO4: Relate classical texts to practical Yoga
CO5: Develop scriptural understanding and interpretation

Detailed Syllabus

Unit I
Introduction to Yogic literature; historical background; classification of Yogic texts; authorship and chronology; oral tradition; commentary traditions; scriptural authority; relevance of classical texts; interpretative approaches.

Unit II
Yoga Sutras structure; Samadhi Pada overview; definitions of Yoga; Chitta Vritti; Abhyasa and Vairagya; types of Samadhi; obstacles and aids; foundational philosophical constructs; mental discipline framework.

Unit III
Sadhana Pada concepts; Kriya Yoga; Kleshas; Karma theory; Ashtanga Yoga overview; ethical and disciplinary foundations; integration of practice and philosophy; self-regulation principles.

Unit IV
Hatha Yoga Pradipika background; objectives of Hatha Yoga; role of body purification; Shatkarma overview; importance of Asana and Pranayama; energy balance; preparatory practices; spiritual progression.

Unit V
Comparative understanding; Raja Yoga and Hatha Yoga; philosophical convergence; practical applications; relevance to health and therapy; contemporary interpretations; integrative Yogic framework; holistic development.

Text Books

1. Patanjali. (2014). *Yoga Sutras* (S. Satchidananda, Trans.). Integral Yoga.
2. Swatmarama. (2012). *Hatha Yoga Pradipika* (S. S. Saraswati, Trans.). Yoga Publications Trust.
3. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
4. Taimni, I. K. (2015). *The Science of Yoga*. Theosophical Publishing House.
5. Iyengar, B. K. S. (2015). *Light on Yoga*. HarperCollins.

Reference Books

1. Vivekananda, S. (2010). *Raja Yoga*. Advaita Ashrama.
2. Desikachar, T. K. V. (2014). *The Heart of Yoga*. Inner Traditions.
3. Mallinson, J., & Singleton, M. (2017). *Roots of Yoga*. Penguin.
4. Saraswati, S. S. (2011). *Four Chapters on Freedom*. Yoga Publications Trust.
5. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Basic Yogic Practices (Asana & Shatkarma)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop foundational Yogic practice skills
2. To learn basic Asanas and Shatkarmas
3. To cultivate body awareness and discipline
4. To ensure safe and systematic practice
5. To integrate practice with theoretical knowledge

Course Outcomes

CO1: Perform basic Asanas with alignment
CO2: Practice Shatkarma techniques safely
CO3: Demonstrate body awareness and control
CO4: Apply Yogic discipline in daily practice
CO5: Integrate practice with health objectives

List of Experiments / Exercises

1. Practice of loosening exercises and Sukshma Vyayama focusing on joint mobility, muscular warm-up, coordinated movements, and injury prevention principles.
2. Performance of standing Asanas including Tadasana, Vrikshasana, and Trikonasana emphasizing balance, posture alignment, breathing coordination, and stability development.
3. Practice of sitting Asanas such as Padmasana, Vajrasana, and Sukhasana focusing on spinal alignment, flexibility, and meditative posture readiness.
4. Practice of prone Asanas including Bhujangasana and Shalabhasana emphasizing spinal extension, muscular strengthening, and postural awareness.
5. Practice of supine Asanas such as Shavasana and Setu Bandhasana focusing on relaxation response, breath awareness, and restorative techniques.
6. Demonstration and practice of Neti Kriya using traditional tools, nasal cleansing methods, hygiene protocols, and safety precautions.
7. Practice of Kapalabhati as a preparatory cleansing technique focusing on abdominal activation, respiratory rhythm, and contraindication awareness.
8. Practice of Dhauti techniques in simplified form emphasizing digestive cleansing concepts, supervision requirements, and physiological effects.
9. Integrated Asana sequence practice combining standing, sitting, prone, and supine postures with smooth transitions and breath synchronization.
10. Session on safety guidelines, contraindications, and self-observation during Yogic practices emphasizing responsible and ethical practice.

Expected Outcomes

Improved flexibility, strength, balance, respiratory efficiency, body awareness, discipline, and foundational Yogic practice competence.

Evaluation Scheme

Continuous Assessment (50%) + Practical Examination (50%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To enhance English language proficiency

2. To develop effective communication skills
3. To improve listening, speaking, reading, writing abilities
4. To cultivate professional communication competence
5. To support academic and professional interactions

Course Outcomes

CO1: Communicate effectively in English
CO2: Demonstrate professional speaking skills
CO3: Apply reading and writing strategies
CO4: Use language appropriately in formal contexts
CO5: Develop interpersonal communication abilities

Detailed Syllabus

Unit I
Basics of communication; verbal and non-verbal components; barriers to communication; listening skills; feedback mechanisms; interpersonal communication dynamics; cultural sensitivity; clarity and coherence principles.

Unit II
English grammar essentials; sentence structures; parts of speech; tenses usage; common errors; vocabulary development; word formation; functional grammar; accuracy and fluency balance.

Unit III
Reading skills; comprehension techniques; skimming and scanning; academic texts; note-making; summarization skills; interpretation strategies; critical reading approaches; information extraction.

Unit IV
Writing skills; paragraph construction; coherence and cohesion; formal letters; emails; reports; basic documentation; clarity and conciseness; professional tone; structural organization.

Unit V
Speaking skills; pronunciation basics; stress and intonation; group discussions; presentations; interviews; confidence building; body language; professional etiquette; audience awareness.

Text Books

1. Raman, M., & Sharma, S. (2019). *Technical Communication*. Oxford University Press.
2. Rao, S. P. D. (2018). *English for Engineers and Technologists*. McGraw-Hill.
3. Murphy, R. (2016). *English Grammar in Use*. Cambridge University Press.

4. Eastwood, J. (2017). *Oxford Guide to English Grammar*. Oxford University Press.
5. Taylor, S. (2017). *Communication for Business*. Pearson.

Reference Books

1. Bhatnagar, R. (2019). *Communication Skills*. Pearson.
2. Krizan, A. C., et al. (2016). *Business Communication*. Cengage.
3. Jain, V. K., & Sharma, S. (2018). *Professional Communication*. McGraw-Hill.
4. Lucas, S. E. (2019). *The Art of Public Speaking*. McGraw-Hill.
5. Guffey, M. E., & Loewy, D. (2018). *Essentials of Business Communication*. Cengage.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Practical Orientation / Ashram Exposure

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To provide experiential exposure to Yogic institutions
2. To observe traditional Yogic practices
3. To understand Ashram lifestyle and discipline
4. To integrate theory with lived practice
5. To cultivate ethical and reflective learning

Course Outcomes

CO1: Observe traditional Yogic practices
CO2: Understand institutional Yogic environments
CO3: Relate theory with experiential learning
CO4: Demonstrate discipline and ethical conduct
CO5: Reflect on personal learning experiences

Guidelines

Institutional orientation; supervised participation; observation records; reflective diary maintenance; adherence to ethical and disciplinary norms.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER II

Human Anatomy & Physiology – II

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand systemic human physiology
2. To analyze cardiovascular and respiratory systems
3. To study digestive, endocrine, and excretory systems
4. To relate physiological functions with Yogic practices
5. To develop applied physiological understanding

Course Outcomes

CO1: Explain functions of major organ systems
CO2: Analyze cardiovascular and respiratory physiology
CO3: Understand digestive and metabolic regulation
CO4: Correlate Yogic practices with physiological responses
CO5: Apply physiological concepts to health promotion

Detailed Syllabus

Unit I
Cardiovascular system organization; heart anatomy; cardiac cycle phases; blood pressure regulation; blood composition; vascular dynamics; cardiac output control; homeostatic mechanisms; physiological adaptations to activity.

Unit II
Respiratory system anatomy; lungs and airways; mechanics of breathing; gas exchange processes; oxygen transport; carbon dioxide regulation; respiratory volumes; neural and chemical control; exercise adaptations.

Unit III
Digestive system overview; gastrointestinal tract organization; digestion and absorption processes; digestive enzymes; liver and pancreas functions; metabolism integration; nutritional assimilation; gastrointestinal regulation.

Unit IV
Endocrine system fundamentals; hormone classification; pituitary, thyroid, adrenal glands; hormonal regulation; feedback mechanisms; stress physiology; metabolic balance; growth and development control.

Unit V
Excretory system structure; kidney anatomy; nephron function; urine formation; fluid electrolyte balance; acid base regulation; integumentary overview; thermoregulation; homeostatic integration.

Text Books

1. Guyton, A. C., & Hall, J. E. (2020). *Textbook of Medical Physiology*. Elsevier.
2. Tortora, G. J., & Derrickson, B. H. (2021). *Principles of Anatomy and Physiology*. Wiley.
3. Marieb, E. N., & Hoehn, K. (2018). *Human Anatomy & Physiology*. Pearson.
4. Widmaier, E. P., Raff, H., & Strang, K. T. (2019). *Vander's Human Physiology*. McGraw-Hill.
5. Ganong, W. F. (2018). *Review of Medical Physiology*. McGraw-Hill.

Reference Books

1. Standring, S. (2020). *Gray's Anatomy*. Elsevier.
2. Moore, K. L., Dalley, A. F., & Agur, A. M. (2019). *Clinically Oriented Anatomy*. Wolters Kluwer.
3. Sherwood, L. (2017). *Human Physiology*. Cengage.
4. Barrett, K. E., et al. (2019). *Ganong's Review of Medical Physiology*. McGraw-Hill.
5. Silverthorn, D. U. (2018). *Human Physiology*. Pearson.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Philosophy of Yoga & Indian Thought

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To study philosophical foundations of Yoga
2. To understand Indian schools of thought
3. To analyze metaphysical and epistemological concepts
4. To integrate philosophy with Yogic practice
5. To cultivate critical philosophical understanding

Course Outcomes

CO1: Explain major Indian philosophical systems
CO2: Interpret Yogic philosophy concepts
CO3: Analyze metaphysical principles of Yoga
CO4: Relate philosophy to practice and ethics
CO5: Develop philosophical reasoning skills

Detailed Syllabus

Unit I
Nature of philosophy; Indian philosophical outlook; Astika and Nastika systems; sources of knowledge; Pramana concepts; metaphysics and ontology; philosophical inquiry methods; integrative worldview.

Unit II
Samkhya philosophy fundamentals; Purusha and Prakriti; evolution of tattvas; Triguna theory; causation concepts; liberation framework; influence on Yoga philosophy; metaphysical structure.

Unit III
Yoga philosophy principles; Patanjali framework; Chitta and Vritti; Kleshas; Karma and Samskara; liberation concept; epistemology; ethical and practical integration.

Unit IV
Vedanta philosophy overview; Upanishadic thought; Brahman and Atman; Maya and Avidya; liberation pathways; Advaita perspectives; comparative understanding with Yoga.

Unit V
Other schools overview; Nyaya and Vaisheshika logic; Mimamsa ritual philosophy; Buddhism and Jainism perspectives; comparative analysis; relevance to Yogic ethics and practice.

Text Books

1. Radhakrishnan, S. (2008). *Indian Philosophy*. Oxford University Press.
2. Sharma, C. (2011). *Critical Survey of Indian Philosophy*. Motilal Banarsidass.
3. Dasgupta, S. (2009). *A History of Indian Philosophy*. Cambridge University Press.
4. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
5. Hiriyanna, M. (2014). *Outlines of Indian Philosophy*. Motilal Banarsidass.

Reference Books

1. Chatterjee, S., & Datta, D. (2012). *An Introduction to Indian Philosophy*. University of Calcutta.
2. Raju, P. T. (2015). *Structural Depths of Indian Thought*. SUNY Press.

3. Phillips, S. (2013). *Classical Indian Metaphysics*. Motilal Banarsidass.
4. Larson, G. J. (2018). *Classical Samkhya*. Motilal Banarsidass.
5. Vivekananda, S. (2010). *Raja Yoga*. Advaita Ashrama.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yogic Texts – II (Bhagavad Gita & Upanishads)

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To study Bhagavad Gita teachings
2. To understand core Upanishadic concepts
3. To analyze paths of Yoga
4. To relate scriptural wisdom to life practices
5. To cultivate ethical and spiritual understanding

Course Outcomes

CO1: Interpret Bhagavad Gita philosophy
CO2: Explain key Upanishadic concepts
CO3: Analyze Karma, Bhakti, Jnana Yoga paths
CO4: Relate scriptural teachings to daily life
CO5: Develop reflective spiritual insight

Detailed Syllabus

Unit I
Introduction to Bhagavad Gita; historical context; structure and themes; battlefield symbolism; concept of Dharma; crisis and moral dilemma; relevance to human life.

Unit II
Karma Yoga principles; action and duty; Nishkama Karma; selfless service; work ethics; detachment; social responsibility; practical life integration.

Unit III
Bhakti Yoga concepts; devotion and surrender; Ishvara Bhakti; emotional discipline; love and faith; spiritual practices; transformative devotion.

Unit IV
Jnana Yoga framework; knowledge and wisdom; self inquiry; Atman realization; discrimination and detachment; liberation concepts; intellectual discipline.

Unit V
Upanishads overview; Mahavakyas; Brahman and Atman identity; consciousness concepts; ignorance and knowledge; liberation ideals; integrative philosophical vision.

Text Books

1. Easwaran, E. (2016). *The Bhagavad Gita*. Nilgiri Press.
2. Radhakrishnan, S. (2011). *The Bhagavadgita*. HarperCollins.
3. Gambhirananda, S. (2012). *Eight Upanishads*. Advaita Ashrama.
4. Chinmayananda, S. (2014). *The Holy Geeta*. Central Chinmaya Mission Trust.
5. Feuerstein, G. (2018). *The Bhagavad-Gita*. Shambhala.

Reference Books

1. Vivekananda, S. (2010). *Jnana Yoga*. Advaita Ashrama.
2. Müller, M. (2014). *The Upanishads*. Dover Publications.
3. Radhakrishnan, S. (2008). *Indian Philosophy*. Oxford University Press.
4. Sivananda, S. (2016). *All About the Bhagavad Gita*. Divine Life Society.
5. Easwaran, E. (2017). *Essence of the Upanishads*. Nilgiri Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Nutrition, Dietetics & Yogic Lifestyle

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand principles of human nutrition
2. To study dietary requirements and metabolism
3. To analyze Yogic dietary concepts
4. To promote healthy lifestyle practices
5. To integrate nutrition with Yoga

Course Outcomes

CO1: Explain nutritional principles
CO2: Analyze dietary components and functions
CO3: Understand Yogic dietary classifications
CO4: Promote balanced lifestyle practices
CO5: Apply nutrition concepts for health

Detailed Syllabus

Unit I
Nutrition fundamentals; macro and micronutrients; carbohydrates, proteins, fats; vitamins and minerals; energy requirements; balanced diet concepts; nutritional assessment.

Unit II
Digestion and metabolism; nutrient absorption; metabolic pathways; basal metabolic rate; energy balance; dietary planning; meal patterns; physiological needs.

Unit III
Yogic diet principles; Sattvic, Rajasic, Tamasic foods; Ahara concepts; moderation and timing; digestive fire; mindful eating; lifestyle harmony.

Unit IV
Diet in health maintenance; immunity support; weight management; lifestyle disorders prevention; hydration; seasonal dietary adaptations; holistic wellness.

Unit V
Dietary guidelines; traditional Indian diets; therapeutic nutrition basics; integration with Yoga therapy; ethical eating; sustainability considerations.

Text Books

1. Mahan, L. K., & Raymond, J. L. (2020). *Krause's Food & the Nutrition Care Process*. Elsevier.
2. Wardlaw, G. M., & Smith, A. M. (2018). *Contemporary Nutrition*. McGraw-Hill.
3. Gopalan, C., et al. (2016). *Nutritive Value of Indian Foods*. NIN.
4. Sivananda, S. (2015). *Yoga and Nutrition*. Divine Life Society.
5. Whitney, E., & Rolfes, S. (2019). *Understanding Nutrition*. Cengage.

Reference Books

1. Mudambi, S. R., & Rajagopal, M. V. (2017). *Fundamentals of Foods and Nutrition*. New Age.
2. McArdle, W. D., et al. (2018). *Exercise Physiology*. Wolters Kluwer.
3. WHO. (2019). *Healthy Diet*. World Health Organization.
4. Sharma, P. V. (2014). *Ayurveda and Nutrition*. Chaukhambha.

5. Sizer, F., & Whitney, E. (2017). *Nutrition: Concepts and Controversies*. Cengage.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Pranayama & Meditation Techniques

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop Pranayama practice skills
2. To understand breath regulation techniques
3. To learn meditation fundamentals
4. To cultivate mental discipline
5. To integrate practice with health benefits

Course Outcomes

CO1: Perform basic Pranayama techniques
CO2: Practice breath awareness and control
CO3: Demonstrate meditation readiness
CO4: Apply techniques for stress regulation
CO5: Integrate practices into daily routine

List of Experiments / Exercises

1. Practice of diaphragmatic breathing techniques focusing on awareness, posture alignment, breath rhythm regulation, and relaxation response development.
2. Practice of sectional breathing including abdominal, thoracic, and clavicular regions emphasizing coordination, lung capacity enhancement, and respiratory control.
3. Performance of Nadishodhana Pranayama with controlled inhalation and exhalation focusing on nervous balance and mental calmness.
4. Practice of Bhramari Pranayama emphasizing sound resonance, breath prolongation, and parasympathetic activation.
5. Practice of Ujjayi Pranayama focusing on glottis control, breath awareness, and meditative preparation.
6. Introduction to breath retention techniques with safety guidelines, gradual progression, and physiological awareness.

7. Practice of Om chanting focusing on vibration awareness, concentration, and mental centering.
8. Guided meditation practice focusing on posture stability, breath observation, and thought regulation.
9. Practice of mindfulness meditation emphasizing present moment awareness, sensory observation, and emotional regulation.
10. Session on contraindications, safety measures, and ethical practice of Pranayama and meditation techniques.

Expected Outcomes

Improved respiratory efficiency, mental clarity, emotional balance, stress regulation, concentration, and foundational meditative competence.

Evaluation Scheme

Continuous Assessment (50%) + Practical Examination (50%)

Design Thinking & Holistic Living

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To introduce design thinking concepts
2. To apply holistic problem solving approaches
3. To integrate creativity with Yogic principles
4. To promote sustainable living practices
5. To develop innovation mindset

Course Outcomes

CO1: Understand design thinking framework
CO2: Apply creative problem solving
CO3: Integrate holistic living concepts
CO4: Develop sustainable lifestyle solutions
CO5: Demonstrate innovative thinking skills

Detailed Syllabus

Unit I
Design thinking overview; empathy concept; user centered approach; problem identification; observation techniques; holistic perspectives; contextual understanding.

Unit II
Ideation processes; creativity tools; brainstorming methods; divergent and convergent thinking; solution generation; collaborative approaches.

Unit III
Prototyping fundamentals; concept visualization; low fidelity models; iterative refinement; feedback integration; practical testing.

Unit IV
Holistic living concepts; sustainability principles; balance of body mind environment; Yogic lifestyle integration; ethical innovation.

Unit V
Application cases; wellness solutions; community challenges; social innovation; reflective practices; implementation strategies.

Text Books

1. Brown, T. (2019). *Change by Design*. Harper Business.
2. Liedtka, J., & Ogilvie, T. (2018). *Designing for Growth*. Columbia University Press.
3. IDEO. (2015). *The Field Guide to Human-Centered Design*. IDEO.org.
4. Senge, P. (2017). *The Fifth Discipline*. Doubleday.
5. Sivananda, S. (2016). *Yoga for Holistic Living*. Divine Life Society.

Reference Books

1. Kelley, T., & Kelley, D. (2013). *Creative Confidence*. Crown.
2. Meadows, D. (2015). *Thinking in Systems*. Chelsea Green.
3. Fry, T. (2011). *Design as Politics*. Berg.
4. Brown, V. A. (2010). *Collective Wisdom*. Earthscan.
5. Capra, F. (2014). *The Systems View of Life*. Cambridge University Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship / Community Yoga Practice

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To provide community based Yoga exposure

2. To apply Yogic practices in real settings
3. To develop teaching and interaction skills
4. To understand social responsibility
5. To cultivate professional discipline

Course Outcomes

CO1: Conduct basic community Yoga sessions
CO2: Apply Yogic knowledge practically
CO3: Demonstrate communication and teaching skills
CO4: Understand community health needs
CO5: Exhibit ethical and professional conduct

Guidelines

Community engagement; supervised practice; session planning; participation records; reflective reporting; ethical adherence.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER III

Kinesiology & Biomechanics in Yoga

Course Category: Basic Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand principles of human movement science
2. To study biomechanical foundations of Yoga postures
3. To analyze joint mechanics and muscular actions
4. To prevent injury through biomechanical awareness
5. To integrate movement science with Yogic practice

Course Outcomes

CO1: Explain fundamental kinesiology concepts
CO2: Analyze biomechanical principles in Yoga
CO3: Identify joint movements and muscle actions
CO4: Apply biomechanics for posture correction
CO5: Enhance safety and efficiency in practice

Detailed Syllabus

Unit I
Kinesiology fundamentals, scope and objectives; planes and axes of movement; types of body movements; anatomical reference positions; posture analysis; alignment concepts; movement terminology; functional anatomy integration; Yoga movement relevance.

Unit II
Biomechanics principles; force, torque, leverage systems; Newton laws application; center of gravity; stability and balance; mechanical efficiency; stress and strain; load distribution; biomechanical analysis of Yogic movements.

Unit III
Joint mechanics; synovial joint structure; degrees of freedom; range of motion; joint stability factors; ligament and tendon roles; joint actions during Asanas; mobility and stability balance; injury mechanisms.

Unit IV
Muscle physiology in movement; muscle fiber types; agonist antagonist synergy; concentric eccentric isometric actions; neuromuscular coordination; muscle recruitment patterns; strength flexibility balance; Yogic posture control.

Unit V
Application to Yoga practice; biomechanical analysis of standing sitting prone supine Asanas; movement sequencing; alignment correction strategies; injury prevention principles; ergonomic considerations; individualized practice adaptation.

Text Books

1. Neumann, D. A. (2017). *Kinesiology of the Musculoskeletal System*. Elsevier.
2. McGinnis, P. M. (2020). *Biomechanics of Sport and Exercise*. Human Kinetics.
3. Hall, S. J. (2018). *Basic Biomechanics*. McGraw-Hill.
4. Hamill, J., & Knutzen, K. (2019). *Biomechanical Basis of Human Movement*. Wolters Kluwer.
5. Kapandji, I. A. (2014). *Physiology of the Joints*. Churchill Livingstone.

Reference Books

1. Kendall, F. P., et al. (2015). *Muscles Testing and Function*. Lippincott.
2. Magee, D. J. (2014). *Orthopedic Physical Assessment*. Elsevier.
3. Moore, K. L., et al. (2019). *Clinically Oriented Anatomy*. Wolters Kluwer.
4. Kisner, C., & Colby, L. (2017). *Therapeutic Exercise*. F.A. Davis.
5. Alter, M. J. (2004). *Science of Flexibility*. Human Kinetics.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Psychology of Yoga & Mindfulness

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand psychological foundations of Yoga
2. To study mind behavior relationship
3. To analyze mindfulness concepts
4. To integrate Yogic psychology with wellbeing
5. To develop mental self regulation skills

Course Outcomes

CO1: Explain Yogic psychological concepts
CO2: Analyze mind processes and behavior
CO3: Apply mindfulness principles
CO4: Enhance emotional regulation
CO5: Integrate Yoga psychology in daily life

Detailed Syllabus

Unit I
Introduction to psychology; modern and Yogic perspectives; mind body relationship; consciousness concepts; Chitta structure; Manas Buddhi Ahamkara; mental functions; perception cognition emotion integration; Yogic psychology framework.

Unit II
Stress psychology; stressors and responses; autonomic regulation; psychosomatic linkages; coping mechanisms; Yogic stress management concepts; relaxation response; resilience building; adaptive behavior patterns.

Unit III
Mindfulness foundations; attention and awareness; present moment focus; sensory awareness; cognitive flexibility; non judgemental observation; emotional balance; mindfulness based self regulation principles.

Unit IV
Emotions and personality; emotional intelligence; Gunas influence; personality typologies; motivation and behavior; self concept development; emotional regulation through Yoga practices; psychological harmony.

Unit V
Applications of Yoga psychology; mental health promotion; anxiety depression management; positive psychology integration; lifestyle modification; wellbeing enhancement; ethical psychological practice considerations.

Text Books

1. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
2. Rao, K. R. (2011). *Foundations of Yoga Psychology*. Indian Council of Philosophical Research.
3. Kabat Zinn, J. (2016). *Mindfulness for Beginners*. Sounds True.
4. Baron, R. A. (2018). *Psychology*. Pearson.
5. Goleman, D. (2017). *Emotional Intelligence*. Bantam.

Reference Books

1. Brown, K. W., et al. (2015). *Handbook of Mindfulness*. Guilford Press.
2. Ryff, C. (2014). *Psychological Well Being*. Springer.

3. Snyder, C. R. (2018). *Positive Psychology*. Sage.
4. Sivananda, S. (2016). *Mind Its Mysteries and Control*. Divine Life Society.
5. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yoga for Health Promotion & Disease Prevention

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand preventive health concepts
2. To apply Yoga for health promotion
3. To study lifestyle disease prevention
4. To integrate Yoga with public health
5. To promote holistic wellbeing

Course Outcomes

CO1: Explain health promotion principles
CO2: Apply Yoga in preventive health
CO3: Identify lifestyle disease risk factors
CO4: Design basic Yoga wellness programs
CO5: Promote holistic health practices

Detailed Syllabus

Unit I
Concept of health and wellness; WHO health dimensions; preventive medicine levels; lifestyle determinants; Yogic health model; holistic wellbeing components; mind body integration; self care principles.

Unit II
Yoga for physical fitness; flexibility strength endurance balance; cardiovascular health; respiratory efficiency; metabolic regulation; posture correction; musculoskeletal health maintenance.

Unit III
Yoga for mental health; stress anxiety depression prevention; autonomic balance; emotional stability; sleep quality improvement; relaxation techniques; mindfulness integration.

Unit IV
Lifestyle disorders overview; obesity diabetes hypertension; cardiovascular risks; Yogic preventive strategies; dietary lifestyle integration; behavior modification principles.

Unit V
Public health perspectives; community Yoga programs; health education strategies; wellness promotion models; ethical considerations; evidence based Yoga practice integration.

Text Books

1. Nagarathna, R., & Nagendra, H. R. (2014). *Yoga for Promotion of Health*. Swami Vivekananda Yoga Prakashana.
2. Sivananda, S. (2015). *Yoga Asanas*. Divine Life Society.
3. McArdle, W. D., et al. (2018). *Exercise Physiology*. Wolters Kluwer.
4. WHO. (2019). *Guidelines on Physical Activity*. World Health Organization.
5. Iyengar, B. K. S. (2015). *Light on Yoga*. HarperCollins.

Reference Books

1. Sharma, R., et al. (2016). *Yoga Therapy*. Jaypee.
2. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
3. Nagendra, H. R. (2010). *Yoga for Health*. Swami Vivekananda Yoga Prakashana.
4. Bouchard, C. (2014). *Physical Activity and Health*. Human Kinetics.
5. Selye, H. (2017). *The Stress of Life*. McGraw Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Stress Management & Mental Well-being

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand stress mechanisms
2. To analyze psychosocial stressors
3. To apply Yogic stress management techniques
4. To promote mental wellbeing
5. To develop coping strategies

Course Outcomes

CO1: Explain stress physiology
CO2: Identify stress sources and effects
CO3: Apply Yoga based stress management
CO4: Enhance mental wellbeing
CO5: Demonstrate adaptive coping skills

Detailed Syllabus

Unit I
Stress concepts and definitions; eustress distress; physiological stress response; HPA axis; autonomic nervous system role; adaptation stages; stress measurement indicators.

Unit II
Psychological stressors; work family social stress; cognitive appraisal; emotional responses; behavioral outcomes; burnout concepts; mental health implications.

Unit III
Yogic stress management; Asana Pranayama practices; relaxation techniques; Yoga Nidra; breath regulation; parasympathetic activation; mind body balance.

Unit IV
Meditation and mindfulness; attention regulation; emotional awareness; cognitive restructuring; resilience development; mental clarity; wellbeing enhancement.

Unit V
Lifestyle management strategies; time management; sleep hygiene; diet exercise integration; social support; ethical living; sustainable wellbeing practices.

Text Books

1. Seaward, B. L. (2018). *Managing Stress*. Jones & Bartlett.
2. Everly, G. S. (2017). *A Clinical Guide to the Treatment of the Human Stress Response*. Springer.
3. Sivananda, S. (2016). *Mind Its Mysteries and Control*. Divine Life Society.
4. Kabat Zinn, J. (2016). *Full Catastrophe Living*. Bantam.
5. Goleman, D. (2017). *Emotional Intelligence*. Bantam.

Reference Books

1. Lazarus, R. S. (2014). *Stress and Emotion*. Springer.
2. Benson, H. (2010). *The Relaxation Response*. Harper.
3. Ryff, C. (2014). *Psychological Well Being*. Springer.
4. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

5. Selye, H. (2017). *The Stress of Life*. McGraw Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Research Methods in Yoga & Life Sciences

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand research fundamentals
2. To develop scientific inquiry skills
3. To study research designs and methods
4. To promote evidence based Yoga studies
5. To build academic research competence

Course Outcomes

CO1: Explain research methodology concepts
CO2: Design basic research studies
CO3: Apply data collection methods
CO4: Interpret research findings
CO5: Demonstrate ethical research practice

Detailed Syllabus

Unit I
Research fundamentals; scientific method; research objectives; hypothesis formulation; variables and controls; qualitative quantitative approaches; interdisciplinary research relevance.

Unit II
Research designs; experimental observational designs; sampling techniques; population selection; validity reliability concepts; bias control; methodological rigor.

Unit III
Data collection tools; questionnaires interviews observations; physiological measurements; Yoga intervention protocols; data recording procedures.

Unit IV
Basic statistics; data organization; descriptive statistics; graphical representation; interpretation principles; introduction to inferential concepts.

Unit V
Research ethics; informed consent; confidentiality; plagiarism avoidance; reporting standards; basic research proposal structure; academic integrity.

Text Books

1. Creswell, J. W. (2018). *Research Design*. Sage.
2. Kothari, C. R. (2017). *Research Methodology*. New Age.
3. Thomas, J. R., et al. (2015). *Research Methods in Physical Activity*. Human Kinetics.
4. Bernard, H. R. (2017). *Research Methods in Anthropology*. Rowman.
5. Nagendra, H. R. (2010). *Research Methods in Yoga*. Swami Vivekananda Yoga Prakashana.

Reference Books

1. Cohen, L., et al. (2018). *Research Methods in Education*. Routledge.
2. Field, A. (2018). *Discovering Statistics Using SPSS*. Sage.
3. American Psychological Association. (2020). *Publication Manual*. APA.
4. WHO. (2019). *Research Ethics Guidelines*. World Health Organization.
5. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Humanities Elective (Ethics / Indian Constitution)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To understand ethical civic values
2. To study constitutional principles
3. To promote responsible citizenship
4. To integrate ethics with professional life
5. To develop social awareness

Course Outcomes

CO1: Explain ethical principles
CO2: Understand constitutional values

CO3: Apply ethics in professional contexts
CO4: Demonstrate civic responsibility
CO5: Promote social harmony

Detailed Syllabus

Unit I
Ethics fundamentals; moral philosophy; values and virtues; ethical decision making; professional ethics; social responsibility.

Unit II
Indian Constitution overview; Preamble; fundamental rights; duties; directive principles; constitutional values.

Unit III
Justice liberty equality; secularism democracy; citizenship concepts; governance structures; rule of law.

Unit IV
Ethics in public life; integrity accountability transparency; corruption issues; ethical leadership; civic engagement.

Unit V
Contemporary ethical issues; social justice; environmental ethics; digital citizenship; national integration.

Text Books

1. Subba Rao, P. (2016). *Ethics, Integrity and Aptitude*. McGraw Hill.
2. Basu, D. D. (2018). *Introduction to the Constitution of India*. LexisNexis.
3. Velasquez, M. (2014). *Business Ethics*. Pearson.
4. Sharma, B. (2017). *Indian Polity*. McGraw Hill.
5. Sen, A. (2010). *The Idea of Justice*. Penguin.

Reference Books

1. Gauba, O. P. (2019). *An Introduction to Political Theory*. Macmillan.
2. Ghosh, P. K. (2018). *Ethics and Governance*. Oxford.
3. NCERT. (2019). *Indian Constitution at Work*. NCERT.
4. Rawls, J. (2016). *A Theory of Justice*. Harvard.
5. Capra, F. (2014). *The Systems View of Life*. Cambridge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To gain supervised professional exposure
2. To apply Yogic knowledge in field settings
3. To develop practical teaching skills
4. To understand organizational functioning
5. To cultivate professional discipline

Course Outcomes

CO1: Perform assigned professional tasks
CO2: Apply Yoga practices in real contexts
CO3: Demonstrate communication skills
CO4: Follow ethical professional conduct
CO5: Submit reflective internship report

Guidelines

Institutional attachment; supervised practice; task documentation; attendance records; reflective report submission; ethical compliance.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER IV

Therapeutic Applications of Yoga

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To understand therapeutic foundations of Yoga
2. To study Yoga applications for common disorders
3. To integrate Yoga with healthcare systems
4. To develop condition specific Yoga modules
5. To promote safe and ethical Yoga therapy

Course Outcomes

CO1: Explain principles of Yoga therapy
CO2: Identify Yogic interventions for disorders
CO3: Design basic therapeutic Yoga modules
CO4: Apply safety and contraindication guidelines
CO5: Integrate Yoga with wellness practices

Detailed Syllabus

Unit I
Concept of Yoga therapy; scope and limitations; preventive promotive curative aspects; mind body interaction; psychosomatic basis; therapeutic principles; assessment parameters; individualized approach; ethical considerations.

Unit II
Yoga therapy for musculoskeletal disorders; back pain cervical spondylosis; joint stiffness arthritis; posture correction; flexibility strengthening balance; movement awareness; lifestyle integration.

Unit III
Yoga therapy for metabolic disorders; obesity diabetes thyroid imbalance; metabolic regulation; Asana Pranayama selection; dietary lifestyle coordination; preventive strategies; long term management.

Unit IV
Yoga therapy for respiratory disorders; asthma bronchitis allergic conditions; lung capacity improvement; breathing regulation; relaxation techniques; autonomic balance; symptom management.

Unit V
Yoga therapy for mental health conditions; stress anxiety depression; emotional regulation; relaxation meditation techniques; sleep improvement; wellbeing enhancement; referral and collaboration principles.

Text Books

1. Nagendra, H. R., & Nagarathna, R. (2014). *Yoga Therapy*. Swami Vivekananda Yoga Prakashana.
2. Sharma, R., et al. (2016). *Yoga Therapy*. Jaypee.
3. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
4. Iyengar, B. K. S. (2015). *Light on Yoga*. HarperCollins.
5. Sivananda, S. (2016). *Yoga Asanas*. Divine Life Society.

Reference Books

1. Telles, S. (2017). *Yoga in Health and Disease*. Springer.
2. McCall, T. (2016). *Yoga as Medicine*. Bantam.
3. Benson, H. (2010). *The Relaxation Response*. Harper.
4. WHO. (2019). *Traditional Medicine Strategy*. World Health Organization.
5. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Lifestyle Disorders & Yogic Management

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand lifestyle related disorders
2. To analyze risk factors and prevention
3. To apply Yogic management strategies
4. To promote healthy behavior modification
5. To integrate Yoga with lifestyle medicine

Course Outcomes

CO1: Identify common lifestyle disorders
CO2: Explain causative lifestyle factors
CO3: Apply Yoga based management strategies
CO4: Promote preventive lifestyle changes
CO5: Support long term health maintenance

Detailed Syllabus

Unit I
Lifestyle disorders overview; epidemiology trends; urbanization impact; behavioral risk factors; physical inactivity; stress influence; dietary imbalance; preventive healthcare concepts.

Unit II
Obesity and metabolic syndrome; causes and consequences; body composition; Yogic interventions; Asana Pranayama practices; dietary lifestyle coordination.

Unit III
Diabetes and hypertension; pathophysiology basics; stress metabolism linkages; Yoga based management; relaxation practices; autonomic balance; lifestyle adherence.

Unit IV
Cardiovascular disorders; risk profiling; physical activity role; Yogic fitness approaches; breathing regulation; mental calmness; preventive strategies.

Unit V
Integrated lifestyle management; behavior modification; habit formation; community awareness; long term compliance; ethical responsibility; health education.

Text Books

1. McArdle, W. D., et al. (2018). *Exercise Physiology*. Wolters Kluwer.
2. Nagendra, H. R. (2010). *Yoga for Lifestyle Disorders*. Swami Vivekananda Yoga Prakashana.
3. WHO. (2019). *Global Health Risks*. World Health Organization.
4. Sivananda, S. (2015). *Yoga and Health*. Divine Life Society.
5. Bouchard, C. (2014). *Physical Activity and Health*. Human Kinetics.

Reference Books

1. Sharma, R. (2016). *Yoga Therapy*. Jaypee.
2. Telles, S. (2017). *Yoga in Health and Disease*. Springer.
3. Ornish, D. (2010). *The Spectrum*. Ballantine.
4. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.

5. Selye, H. (2017). *The Stress of Life*. McGraw Hill.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Ayurveda Fundamentals & Integrative Health

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand fundamentals of Ayurveda
2. To study Tridosha theory
3. To integrate Ayurveda with Yoga
4. To promote holistic health approaches
5. To develop integrative health awareness

Course Outcomes

CO1: Explain basic Ayurvedic concepts
CO2: Identify Prakriti and Dosha characteristics
CO3: Relate Ayurveda with Yoga lifestyle
CO4: Apply integrative health principles
CO5: Promote holistic wellbeing

Detailed Syllabus

Unit I
Ayurveda introduction; historical background; philosophy and objectives; Panchamahabhuta theory; health definition; preventive promotive concepts; holistic approach.

Unit II
Tridosha theory; Vata Pitta Kapha characteristics; Prakriti assessment; Dosha imbalance; health implications; lifestyle relevance.

Unit III
Sapta Dhatu and Mala concepts; tissue metabolism; nutrition assimilation; waste elimination; physiological balance; health maintenance.

Unit IV
Ayurvedic daily regimen; Dinacharya Ritucharya; seasonal adaptation; dietary principles; lifestyle discipline; mind body harmony.

Unit V
Integrative health approaches; Yoga Ayurveda synergy; lifestyle disorders management; preventive strategies; ethical integrative practice.

Text Books

1. Sharma, P. V. (2014). *Charaka Samhita*. Chaukhambha.
2. Lad, V. (2015). *Ayurveda: The Science of Self Healing*. Lotus Press.
3. Dash, B. (2016). *Fundamentals of Ayurveda*. B. Jain.
4. Sivananda, S. (2016). *Ayurveda and Yoga*. Divine Life Society.
5. Tiwari, M. (2017). *Ayurveda Lifestyle Wisdom*. Motilal Banarsidass.

Reference Books

1. Frawley, D. (2014). *Ayurvedic Healing*. Lotus Press.
2. Pole, S. (2013). *Ayurvedic Medicine*. Churchill Livingstone.
3. Sharma, R. (2016). *Yoga Therapy*. Jaypee.
4. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
5. WHO. (2019). *Traditional Medicine Strategy*. World Health Organization.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yoga, Ecology & Sustainable Living

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand ecological principles
2. To relate Yoga philosophy with ecology
3. To promote sustainable living practices
4. To develop environmental responsibility
5. To integrate ethics with sustainability

Course Outcomes

CO1: Explain ecological concepts
CO2: Relate Yoga philosophy to environment
CO3: Promote sustainable lifestyles

CO4: Develop ecological ethics
CO5: Support environmental wellbeing

Detailed Syllabus

Unit I
Ecology fundamentals; ecosystems and biodiversity; human environment interaction; ecological balance; sustainability concepts; environmental challenges.

Unit II
Indian ecological thought; Yogic worldview; harmony with nature; Panchamahabhuta relevance; traditional environmental ethics.

Unit III
Sustainable living principles; consumption patterns; resource conservation; waste management; ecological footprint; mindful living.

Unit IV
Yoga and environmental ethics; Ahimsa Aparigraha; simplicity moderation; social responsibility; community sustainability initiatives.

Unit V
Global sustainability challenges; climate change; lifestyle adaptation; Yoga based ecological awareness; future perspectives.

Text Books

1. Capra, F. (2014). *The Systems View of Life*. Cambridge University Press.
2. Gadgil, M., & Guha, R. (2018). *Ecology and Equity*. Penguin.
3. Shiva, V. (2016). *Earth Democracy*. Zed Books.
4. Sivananda, S. (2016). *Yoga and Ecology*. Divine Life Society.
5. Meadows, D. (2015). *Thinking in Systems*. Chelsea Green.

Reference Books

1. Carson, R. (2017). *Silent Spring*. Houghton.
2. UNEP. (2019). *Global Environment Outlook*. United Nations.
3. Naess, A. (2014). *Ecology of Wisdom*. Counterpoint.
4. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
5. Capra, F. (2014). *The Web of Life*. Anchor.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective I (Meditation Studies / Spiritual Psychology)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To study meditation traditions
2. To understand spiritual psychology concepts
3. To develop contemplative practices
4. To promote inner wellbeing
5. To integrate spirituality with psychology

Course Outcomes

CO1: Explain meditation concepts
CO2: Practice basic contemplative techniques
CO3: Understand spiritual psychology principles
CO4: Enhance self awareness
CO5: Promote inner balance

Detailed Syllabus

Unit I
Meditation concepts; historical origins; concentration and awareness; contemplative traditions; mental discipline foundations.

Unit II
Meditation techniques overview; breath based mantra based methods; posture awareness; attention regulation; practice guidelines.

Unit III
Spiritual psychology concepts; consciousness states; self awareness; ego transcendence; inner growth.

Unit IV
Meditation and mental health; emotional regulation; stress reduction; wellbeing enhancement; ethical practice.

Unit V
Contemporary applications; education health leadership; integrative approaches; personal development; reflective practice.

Text Books

1. Kabat Zinn, J. (2016). *Wherever You Go There You Are*. Hyperion.
2. Walsh, R. (2011). *Essential Spirituality*. Wiley.

3. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.
4. Sivananda, S. (2016). *Meditation and Its Methods*. Divine Life Society.
5. Goleman, D. (2017). *The Meditative Mind*. Tarcher.

Reference Books

1. Brown, K. W. (2015). *Handbook of Mindfulness*. Guilford.
2. Wilber, K. (2017). *Integral Psychology*. Shambhala.
3. Ricard, M. (2015). *Happiness*. Atlantic.
4. Walsh, R. (2013). *Contemplative Psychotherapy*. SUNY.
5. Capra, F. (2014). *The Systems View of Life*. Cambridge.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yoga Therapy Practicum

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To apply Yoga therapy principles
2. To conduct supervised therapeutic sessions
3. To develop assessment skills
4. To ensure safe therapeutic practices
5. To build professional competence

Course Outcomes

CO1: Conduct basic Yoga therapy sessions
CO2: Apply assessment and planning skills
CO3: Demonstrate therapeutic communication
CO4: Follow safety and ethical guidelines
CO5: Document therapeutic outcomes

List of Experiments / Exercises

1. Client assessment practice including case history recording, posture observation, lifestyle analysis, and identification of therapeutic needs.

2. Design of basic Yoga therapy modules for musculoskeletal conditions focusing on safety, progression, and outcome objectives.
3. Supervised practice of therapeutic Asana sessions emphasizing alignment correction, breath coordination, and client feedback.
4. Application of Pranayama techniques for stress related conditions under supervision with monitoring and contraindication awareness.
5. Guided relaxation and Yoga Nidra sessions focusing on mental calmness and therapeutic intent.
6. Observation of senior therapist sessions documenting intervention strategies and client responses.
7. Practice of documentation and progress recording including session notes and outcome tracking.
8. Ethical practice orientation including consent procedures, professional boundaries, and referral protocols.
9. Group therapy session planning focusing on common health conditions and adaptive modifications.
10. Reflective practice session summarizing learning outcomes and therapeutic competence development.

Expected Outcomes

Enhanced therapeutic skills, client assessment competence, ethical awareness, professional confidence, and applied Yoga therapy proficiency.

Evaluation Scheme

Continuous Assessment (50%) + Practical Examination (50%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. To gain field based professional exposure
2. To apply integrative Yoga knowledge
3. To develop service orientation
4. To understand institutional practices
5. To cultivate professional discipline

Course Outcomes

CO1: Perform assigned internship tasks
CO2: Apply Yoga based interventions
CO3: Demonstrate professional conduct
CO4: Maintain institutional discipline
CO5: Submit reflective internship documentation

Guidelines

Institutional placement; supervised practice; activity log maintenance; reflective reporting; ethical compliance.

Evaluation Scheme

Continuous Assessment (100%)

SEMESTER V

Advanced Yoga Practices & Teaching Methodology

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To advance proficiency in Yogic practices
2. To understand teaching methodologies in Yoga
3. To develop instructional and demonstration skills
4. To integrate theory with advanced practice
5. To cultivate professional teaching competence

Course Outcomes

CO1: Perform advanced Yogic practices with precision
CO2: Demonstrate structured Yoga teaching skills
CO3: Design class plans for diverse groups
CO4: Apply safety and alignment principles
CO5: Exhibit professional Yoga instruction competence

Detailed Syllabus

Unit I
Advanced Asana concepts; sequencing principles; dynamic and static practices; alignment refinement; strength flexibility balance; breath movement coordination; practice progression; individual variability considerations.

Unit II
Advanced Pranayama practices; regulation techniques; breath ratios; bandha application; energetic balance; safety precautions; contraindication awareness; practice integration strategies.

Unit III
Meditation advancement; concentration techniques; awareness expansion; internalization processes; mental stability; sustained attention; experiential depth; ethical discipline integration.

Unit IV
Yoga teaching methodology; lesson planning; demonstration skills; verbal cueing; class management; learner assessment; feedback mechanisms; inclusive teaching approaches.

Unit V
Professional teaching practice; ethics and responsibilities; student safety; adaptability for

populations; documentation; reflective teaching practice; continuous professional development.

Text Books

1. Iyengar, B. K. S. (2015). *Light on Yoga*. HarperCollins.
2. Saraswati, S. S. (2012). *Asana Pranayama Mudra Bandha*. Yoga Publications Trust.
3. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
4. Desikachar, T. K. V. (2014). *The Heart of Yoga*. Inner Traditions.
5. Sivananda, S. (2016). *Yoga Asanas*. Divine Life Society.

Reference Books

1. Mallinson, J., & Singleton, M. (2017). *Roots of Yoga*. Penguin.
2. Saraswati, S. S. (2011). *Four Chapters on Freedom*. Yoga Publications Trust.
3. Nagendra, H. R. (2010). *Yoga for Health*. SVYASA.
4. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.
5. McCall, T. (2016). *Yoga as Medicine*. Bantam.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yoga for Special Populations (Children, Elderly, Women)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand Yoga needs of special populations
2. To adapt Yogic practices safely
3. To address age and gender specific considerations
4. To promote inclusive Yoga practices
5. To ensure ethical and safe application

Course Outcomes

CO1: Identify special population requirements
CO2: Modify Yoga practices appropriately
CO3: Apply safety and contraindication guidelines

CO4: Promote wellbeing across life stages
CO5: Demonstrate inclusive teaching competence

Detailed Syllabus

Unit I
Yoga for children; growth and development considerations; attention span; playful practices; posture development; flexibility coordination; learning safety; behavioral regulation.

Unit II
Yoga for adolescents; physical emotional changes; posture correction; stress management; self regulation; confidence building; lifestyle balance.

Unit III
Yoga for elderly; aging physiology; joint mobility; balance stability; fall prevention; breath awareness; relaxation practices; safety modifications.

Unit IV
Yoga for women; reproductive health considerations; menstrual cycle awareness; pregnancy postnatal care basics; hormonal balance; emotional wellbeing.

Unit V
Inclusive Yoga programming; adaptation strategies; contraindications; ethical considerations; community outreach; monitoring outcomes; professional responsibility.

Text Books

1. Nagarathna, R., & Nagendra, H. R. (2014). *Yoga for Children*. SVYASA.
2. Saraswati, S. S. (2012). *Asana Pranayama Mudra Bandha*. Yoga Publications Trust.
3. Sivananda, S. (2015). *Yoga for Women*. Divine Life Society.
4. McArdle, W. D., et al. (2018). *Exercise Physiology*. Wolters Kluwer.
5. Iyengar, B. K. S. (2015). *Light on Yoga*. HarperCollins.

Reference Books

1. Nagendra, H. R. (2010). *Yoga for Senior Citizens*. SVYASA.
2. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
3. Sharma, R. (2016). *Yoga Therapy*. Jaypee.
4. WHO. (2019). *Healthy Ageing*. World Health Organization.
5. Sivananda, S. (2016). *Yoga and Health*. Divine Life Society.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Neuroscience of Meditation & Consciousness

Course Category: Basic Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand neural basis of meditation
2. To study brain and consciousness relationship
3. To analyze neurophysiological correlates
4. To integrate neuroscience with Yogic concepts
5. To develop scientific perspective on meditation

Course Outcomes

CO1: Explain brain structure and function
CO2: Describe neural mechanisms of meditation
CO3: Relate consciousness states with brain activity
CO4: Integrate Yogic and neuroscientific views
CO5: Interpret research findings in meditation studies

Detailed Syllabus

Unit I
Nervous system overview; brain organization; neurons synapses; neural signaling; functional brain regions; cognition emotion regulation; neuroplasticity basics.

Unit II
Consciousness concepts; wakefulness sleep dreaming; altered states; attention awareness; self perception; neural correlates; integrative models.

Unit III
Meditation and brain function; attention networks; default mode network; emotional regulation circuits; stress response modulation; neuroplastic changes.

Unit IV
Neurophysiology of Pranayama; autonomic regulation; heart brain interaction; breath neural pathways; parasympathetic activation; coherence concepts.

Unit V
Research perspectives; neuroimaging methods; EEG fMRI basics; evidence based meditation studies; ethical research considerations; future directions.

Text Books

1. Bear, M. F., et al. (2020). *Neuroscience: Exploring the Brain*. Wolters Kluwer.
2. Goleman, D., & Davidson, R. (2017). *Altered Traits*. Avery.

3. Kandel, E. R., et al. (2021). *Principles of Neural Science*. McGraw Hill.
4. Davidson, R. J. (2018). *The Emotional Life of Your Brain*. Hudson Street.
5. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

Reference Books

1. Siegel, D. J. (2015). *Mindsight*. Bantam.
2. Tang, Y. Y. (2015). *The Neuroscience of Mindfulness*. Springer.
3. Zeman, A. (2016). *Consciousness*. Yale University Press.
4. Telles, S. (2017). *Yoga in Health and Disease*. Springer.
5. WHO. (2019). *Neuroscience and Mental Health*. World Health Organization.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Yoga, Ethics & Professional Practice

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand ethical foundations of Yoga
2. To study professional responsibilities
3. To promote ethical teaching practices
4. To develop professional conduct
5. To integrate values with Yoga practice

Course Outcomes

CO1: Explain Yogic ethical principles
CO2: Apply ethics in professional practice
CO3: Demonstrate responsible teaching conduct
CO4: Uphold professional integrity
CO5: Promote ethical Yoga dissemination

Detailed Syllabus

Unit I
Ethics in Yoga; Yama Niyama principles; moral values; self discipline; social responsibility; personal conduct foundations.

Unit II
Professional ethics; teacher student relationship; boundaries and consent; confidentiality; accountability; ethical decision making.

Unit III
Legal and institutional aspects; certification standards; professional guidelines; safety regulations; compliance requirements.

Unit IV
Ethics in therapeutic practice; scope limitations; referral principles; interdisciplinary collaboration; client welfare priority.

Unit V
Contemporary ethical challenges; commercialization issues; cultural sensitivity; integrity preservation; sustainable professional practice.

Text Books

1. Patanjali. (2014). *Yoga Sutras*. Integral Yoga.
2. Subba Rao, P. (2016). *Ethics, Integrity and Aptitude*. McGraw Hill.
3. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
4. Sharma, B. (2017). *Indian Polity*. McGraw Hill.
5. Sivananda, S. (2016). *Practice of Yoga*. Divine Life Society.

Reference Books

1. Velasquez, M. (2014). *Business Ethics*. Pearson.
2. NCERT. (2019). *Ethics and Human Values*. NCERT.
3. WHO. (2019). *Ethics in Health Practice*. World Health Organization.
4. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.
5. Sen, A. (2010). *The Idea of Justice*. Penguin.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Professional Elective I (Corporate Yoga / Sports Yoga)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand applied professional Yoga domains

2. To study Yoga in corporate or sports settings
3. To design context specific Yoga programs
4. To promote performance and wellbeing
5. To develop professional specialization

Course Outcomes

CO1: Explain applied Yoga concepts
CO2: Design specialized Yoga modules
CO3: Apply Yoga for performance enhancement
CO4: Address occupational health needs
CO5: Demonstrate professional specialization skills

Detailed Syllabus

Unit I
Corporate Yoga concepts; workplace stress; ergonomics; posture correction; productivity enhancement; wellness culture.

Unit II
Yoga for stress management in organizations; relaxation practices; breath regulation; mental focus; emotional balance.

Unit III
Sports Yoga fundamentals; flexibility strength balance; injury prevention; recovery principles; performance optimization.

Unit IV
Training program design; needs assessment; session structuring; monitoring outcomes; safety considerations.

Unit V
Professional practice aspects; client communication; program evaluation; ethical delivery; sustainability considerations.

Text Books

1. McCall, T. (2016). *Yoga as Medicine*. Bantam.
2. McArdle, W. D., et al. (2018). *Exercise Physiology*. Wolters Kluwer.
3. Iyengar, B. K. S. (2015). *Light on Yoga*. HarperCollins.
4. Goleman, D. (2017). *Emotional Intelligence*. Bantam.
5. Sivananda, S. (2016). *Yoga and Health*. Divine Life Society.

Reference Books

1. Nagendra, H. R. (2010). *Yoga for Sports*. SVYASA.

2. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.
3. WHO. (2019). *Workplace Health Promotion*. World Health Organization.
4. Alter, M. J. (2004). *Science of Flexibility*. Human Kinetics.
5. Benson, H. (2010). *The Relaxation Response*. Harper.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Minor Project (Yoga Intervention / Case Study)

Course Category: Project Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. To apply Yoga knowledge in practical context
2. To conduct supervised intervention or case study
3. To develop documentation and analysis skills
4. To integrate research and practice
5. To build professional reporting competence

Course Outcomes

CO1: Identify appropriate project objectives
CO2: Conduct Yoga based intervention or case study
CO3: Analyze outcomes systematically
CO4: Prepare structured project documentation
CO5: Demonstrate ethical project conduct

Guidelines

Problem identification; literature review; intervention planning; supervised execution; data recording; outcome analysis; report preparation; presentation.

Evaluation Scheme

Continuous Assessment (50%) + Project Evaluation (50%)

SEMESTER VI

Yoga Therapy for Chronic & Psychosomatic Disorders

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand chronic and psychosomatic disorder mechanisms
2. To study Yoga based therapeutic approaches
3. To design condition specific Yoga interventions
4. To ensure safety and ethical therapeutic application
5. To integrate Yoga therapy with healthcare systems

Course Outcomes

CO1: Identify chronic and psychosomatic disorders
CO2: Explain Yogic therapeutic principles
CO3: Design basic Yoga therapy modules
CO4: Apply safety and contraindication measures
CO5: Integrate Yoga therapy with holistic care

Detailed Syllabus

Unit I
Chronic disorders overview, disease chronicity concepts; psychosomatic illness models; stress disease linkage; mind body interaction; lifestyle contribution; holistic therapeutic perspective; Yoga therapy scope and limitations.

Unit II
Yoga therapy for psychosomatic disorders; anxiety depression somatoform conditions; emotional dysregulation; relaxation practices; breath regulation; meditation integration; behavioral modification principles.

Unit III
Yoga therapy for musculoskeletal chronic conditions; arthritis spondylosis chronic pain; mobility limitation; posture correction; gentle Asana adaptation; long term management strategies.

Unit IV
Yoga therapy for metabolic and endocrine disorders; diabetes thyroid imbalance obesity; autonomic regulation; Pranayama selection; lifestyle dietary coordination; adherence strategies.

Unit V
Therapeutic planning and monitoring; assessment parameters; progress evaluation; referral principles; interdisciplinary collaboration; ethical therapeutic practice; documentation standards.

Text Books

1. Nagendra, H. R., & Nagarathna, R. (2014). *Yoga Therapy*. Swami Vivekananda Yoga Prakashana.
2. McCall, T. (2016). *Yoga as Medicine*. Bantam.
3. Sharma, R. (2016). *Yoga Therapy*. Jaypee.
4. Sivananda, S. (2016). *Yoga and Health*. Divine Life Society.
5. Feuerstein, G. (2013). *The Yoga Tradition*. Hohm Press.

Reference Books

1. Telles, S. (2017). *Yoga in Health and Disease*. Springer.
2. Benson, H. (2010). *The Relaxation Response*. Harper.
3. WHO. (2019). *Traditional Medicine Strategy*. World Health Organization.
4. Ornish, D. (2010). *The Spectrum*. Ballantine.
5. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Research Writing & Documentation in Yoga Studies

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To develop academic writing skills
2. To understand research documentation standards
3. To apply APA style in Yoga studies
4. To promote ethical scholarly communication
5. To prepare research reports and dissertations

Course Outcomes

CO1: Apply academic writing conventions
CO2: Structure research papers and reports
CO3: Use citation and referencing standards
CO4: Avoid plagiarism through ethical writing
CO5: Prepare publishable scholarly documents

Detailed Syllabus

Unit I
Academic writing fundamentals; scientific communication principles; clarity coherence precision; structure of scholarly writing; audience consideration; formal academic tone; discipline specific writing.

Unit II
Research paper components; abstract introduction methodology results discussion; logical flow; argument development; evidence presentation; critical analysis integration.

Unit III
Citation and referencing; APA style guidelines; in text citation; reference list preparation; source evaluation; plagiarism avoidance; academic integrity.

Unit IV
Thesis and dissertation writing; proposal structure; chapter organization; data presentation; tables figures; appendices; formatting requirements.

Unit V
Publication process; journal selection; peer review process; ethical publishing; research dissemination; presentation and defense skills.

Text Books

1. American Psychological Association. (2020). *Publication Manual of the APA*. APA.
2. Day, R. A., & Gastel, B. (2016). *How to Write and Publish a Scientific Paper*. Cambridge.
3. Swales, J. M., & Feak, C. B. (2012). *Academic Writing for Graduate Students*. Michigan.
4. Creswell, J. W. (2018). *Research Design*. Sage.
5. Kothari, C. R. (2017). *Research Methodology*. New Age.

Reference Books

1. Booth, W. C., et al. (2016). *The Craft of Research*. University of Chicago Press.
2. Murray, R. (2017). *How to Write a Thesis*. Open University Press.
3. Hart, C. (2018). *Doing a Literature Review*. Sage.
4. Belcher, W. L. (2019). *Writing Your Journal Article*. University of Chicago Press.

5. Field, A. (2018). *Discovering Statistics Using SPSS*. Sage.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Emerging Trends in Yoga & Life Sciences

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand contemporary developments in Yoga
2. To study interdisciplinary integration trends
3. To analyze scientific research directions
4. To explore technology enabled Yoga applications
5. To prepare for future professional roles

Course Outcomes

CO1: Identify emerging Yoga trends
CO2: Explain interdisciplinary research integration
CO3: Analyze evidence based Yoga developments
CO4: Apply technology in Yoga dissemination
CO5: Develop future oriented professional awareness

Detailed Syllabus

Unit I
Global evolution of Yoga; contemporary practice trends; institutional frameworks; policy initiatives; Yoga research growth; professional diversification.

Unit II
Yoga and integrative medicine; evidence based practice; clinical research trends; interdisciplinary collaboration; healthcare integration models.

Unit III
Technology in Yoga; digital platforms; tele Yoga; wearable monitoring; biofeedback applications; data driven wellness approaches.

Unit IV
Yoga and mental health research; neuroscience integration; mindfulness interventions; trauma informed Yoga; wellbeing science convergence.

Unit V
Future perspectives; professional opportunities; entrepreneurship in Yoga; ethical challenges; sustainability of Yoga practice dissemination.

Text Books

1. Telles, S. (2017). *Yoga in Health and Disease*. Springer.
2. Goleman, D., & Davidson, R. (2017). *Altered Traits*. Avery.
3. WHO. (2019). *Traditional Medicine Strategy*. World Health Organization.
4. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.
5. Nagendra, H. R. (2010). *Yoga Research*. SVYASA.

Reference Books

1. Davidson, R. J. (2018). *The Emotional Life of Your Brain*. Hudson Street.
2. Kabat Zinn, J. (2016). *Full Catastrophe Living*. Bantam.
3. Capra, F. (2014). *The Systems View of Life*. Cambridge.
4. Walsh, R. (2011). *Essential Spirituality*. Wiley.
5. WHO. (2020). *Mental Health Action Plan*. World Health Organization.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Open Elective II (Integrative Medicine / Spiritual Wellness)

Course Category: Open Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. To understand integrative medicine concepts
2. To study spiritual wellness approaches
3. To integrate Yoga with complementary therapies
4. To promote holistic health models
5. To develop wellness oriented perspectives

Course Outcomes

CO1: Explain integrative medicine principles
CO2: Understand spiritual wellness concepts
CO3: Integrate Yoga with complementary practices

CO4: Promote holistic wellbeing
CO5: Apply wellness models ethically

Detailed Syllabus

Unit I
Integrative medicine overview; complementary therapies; holistic health models; mind body medicine; patient centered care.

Unit II
Spiritual wellness concepts; meaning purpose values; inner wellbeing; self awareness; ethical living foundations.

Unit III
Yoga integration with Ayurveda naturopathy mindfulness; complementary approaches; lifestyle medicine convergence.

Unit IV
Wellness models; preventive healthcare; community wellness programs; policy perspectives; sustainability considerations.

Unit V
Professional application; wellness counseling basics; ethical practice; referral principles; interdisciplinary collaboration.

Text Books

1. Weil, A. (2018). *Integrative Medicine*. Oxford University Press.
2. Dossey, L. (2016). *Reinventing Medicine*. Harper.
3. Walsh, R. (2011). *Essential Spirituality*. Wiley.
4. Sivananda, S. (2016). *Yoga and Health*. Divine Life Society.
5. Capra, F. (2014). *The Systems View of Life*. Cambridge.

Reference Books

1. Benson, H. (2010). *The Relaxation Response*. Harper.
2. WHO. (2019). *Traditional Medicine Strategy*. World Health Organization.
3. Feuerstein, G. (2018). *The Deeper Dimension of Yoga*. Shambhala.
4. Lad, V. (2015). *Ayurveda: The Science of Self Healing*. Lotus Press.
5. Kabat Zinn, J. (2016). *Wherever You Go There You Are*. Hyperion.

Evaluation Scheme

Continuous Assessment (40%) + End-SEMESTER Examination (60%)

Major Project (Research / Field-Based Study)

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. To conduct independent research or field study
2. To apply research methodology in Yoga studies
3. To analyze data and interpret outcomes
4. To develop comprehensive documentation skills
5. To demonstrate professional research competence

Course Outcomes

CO1: Formulate research problem and objectives
CO2: Design and execute research methodology
CO3: Analyze and interpret research data
CO4: Prepare structured project dissertation
CO5: Present and defend research findings

Guidelines

Problem identification; literature review; methodology design; data collection; analysis interpretation; dissertation preparation; oral presentation; ethical compliance.

Evaluation Scheme

Continuous Assessment (40%) + Project Evaluation (60%)

Seminar / Viva-Voce

Course Category: Project Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. To develop seminar presentation skills
2. To assess comprehensive subject understanding
3. To evaluate analytical and communication ability
4. To integrate knowledge across the programme
5. To prepare for professional engagement

Course Outcomes

CO1: Present seminar on approved topic
CO2: Demonstrate subject mastery
CO3: Respond effectively during viva voce
CO4: Integrate interdisciplinary knowledge
CO5: Exhibit professional communication skills

Guidelines

Topic approval; literature survey; seminar presentation; question response; viva voce examination; performance evaluation.

Evaluation Scheme

Seminar Presentation (50%) + Viva-Voce Examination (50%)

Integrated B.Arch. – M.Arch. in Architecture & Engineering

Duration: 6 Years | 12 SEMESTER s | Total Credits: 240

SEMESTER I

Architectural Design Studio – I

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Develop basic architectural design thinking and spatial understanding
2. Introduce fundamental design principles through studio-based exploration
3. Cultivate sensitivity to scale, proportion, and human activities
4. Enhance creativity through form, space, and function integration
5. Build foundational skills in architectural presentation and critique

Course Outcomes
CO1 Ability to conceptualize simple architectural forms
CO2 Application of basic design principles in studio problems
CO3 Visualization of space through drawings and models
CO4 Interpretation of human needs into spatial solutions
CO5 Presentation and communication of design ideas

List of Exercises / Studio Tasks

1. Exploration of point, line, plane relationships using physical and graphical models, focusing on proportion, hierarchy, and compositional balance.
2. Study of geometric transformations through two-dimensional and three-dimensional design exercises using manual modeling techniques.
3. Analysis of basic human activities translated into spatial diagrams and scaled layouts using freehand and drafted drawings.
4. Design of single-space pavilions emphasizing light, ventilation, and enclosure through conceptual sketches and study models.
5. Scale studies using anthropometric data to derive spatial dimensions for small functional spaces.
6. Composition of solids and voids to understand massing, orientation, and visual continuity.

7. Site-neutral design exercises focusing on form evolution and spatial sequencing.
8. Introduction to architectural model making using paper, board, and basic materials.
9. Development of presentation drawings including plans, elevations, and views.
10. Design jury presentation emphasizing verbal articulation, drawings, and models.

Expected Outcomes
Basic architectural design competency, spatial awareness, creative confidence, presentation skills

Evaluation Scheme
Continuous Studio Assessment (100%)

Freehand Drawing & Visual Communication

Course Category: Engineering Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop freehand drawing skills for architectural expression
2. Improve visual observation and representation abilities
3. Introduce architectural sketching conventions
4. Enhance graphic communication through manual techniques
5. Build confidence in visual storytelling

Course Outcomes
CO1 Freehand representation of objects and spaces
CO2 Application of perspective and proportion
CO3 Visual documentation of built environment
CO4 Use of line, tone, and texture effectively
CO5 Communication of ideas through sketches

List of Exercises

1. Line practice exercises focusing on control, weight variation, and hand-eye coordination using pencil and pen.
2. Observation-based sketches of simple objects emphasizing proportion, outline, and depth perception.
3. Shading and tonal rendering exercises using pencil and charcoal for light and shadow representation.

4. Perspective drawing of interior and exterior spaces using one-point and two-point methods.
5. Sketching of natural and built forms to improve visual memory and composition.
6. Study of textures through freehand representation of materials such as brick, wood, and stone.
7. Human figure sketching for scale and activity representation in architectural drawings.
8. Outdoor sketching sessions documenting campus and surrounding environments.
9. Visual narrative exercises combining sketches and annotations.
10. Portfolio compilation of selected drawings demonstrating skill progression.

Expected Outcomes
Enhanced visual communication, sketching proficiency, observational skills

Evaluation Scheme
Continuous Assessment (100%)

Building Materials – I

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand properties of traditional building materials
2. Relate material characteristics to architectural applications
3. Introduce material selection criteria for buildings
4. Develop awareness of sustainability aspects of materials
5. Build foundational knowledge for construction studies

Course Outcomes
CO1 Identification of common building materials
CO2 Understanding material properties and behavior
CO3 Application of materials in building components
CO4 Evaluation of suitability for architectural use
CO5 Awareness of durability and sustainability issues

Detailed Syllabus

Unit I
Building materials classification; stones, geological origin, physical properties, mechanical

characteristics, durability aspects; quarrying methods, dressing techniques; stone masonry applications, architectural use, limitations; weathering effects, testing methods, relevance in contemporary building practices.

Unit II
Bricks and blocks; clay composition, manufacturing processes, burning methods; properties of burnt clay products; types of bricks, standard sizes; tests for strength, absorption, efflorescence; applications in load bearing and infill construction systems.

Unit III
Lime and cement; types of lime, manufacturing processes, properties, uses; Portland cement composition, hydration process, grades; cement tests, storage requirements; comparative analysis of lime and cement in building construction contexts.

Unit IV
Aggregates and mortar; fine and coarse aggregates, sources, grading, properties; mortar types, proportioning, applications; strength, workability, durability aspects; role of aggregates and mortar in masonry and concrete performance.

Unit V
Timber and wood products; tree structure, seasoning methods, defects; properties of timber; engineered wood products; uses in building construction; preservation techniques; sustainability considerations and limitations in architectural applications.

Text Books

1. Arora, S. P., & Bindra, S. P. (2019). *Building materials and construction*. Dhanpat Rai Publishing.
2. Rangwala, S. C. (2020). *Engineering materials*. Charotar Publishing House.
3. Duggal, S. K. (2018). *Building materials*. New Age International.
4. Varghese, P. C. (2017). *Building materials*. PHI Learning.
5. Sharma, S. K. (2016). *Building materials*. S. Chand Publishing.

Reference Books

1. McKay, W. B. (2015). *Building construction*. Longman.
2. Neville, A. M. (2019). *Properties of concrete*. Pearson.
3. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
4. Barry, R. (2016). *The construction of buildings*. Blackwell.
5. Ashby, M. (2018). *Materials for architects and builders*. Butterworth-Heinemann.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

History of Architecture – I

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce architectural evolution in ancient civilizations
2. Understand cultural influences on built forms
3. Develop historical interpretation skills
4. Relate architecture to socio-cultural contexts
5. Build foundation for advanced architectural history

Course Outcomes
CO1 Knowledge of early architectural developments
CO2 Understanding of form, space, and symbolism
CO3 Comparative analysis of ancient civilizations
CO4 Interpretation of historical architectural elements
CO5 Appreciation of architectural heritage

Detailed Syllabus

Unit I
Introduction to architectural history; purpose and methods; prehistoric architecture; megalithic structures, shelters; cultural context, materials, construction techniques; evolution of built forms responding to climate, resources, social organization.

Unit II
Ancient Egyptian architecture; geographical context; mastabas, pyramids, temples; construction systems, symbolism, spatial organization; use of stone, axial planning, monumentality, religious influence on architectural expression.

Unit III
Mesopotamian architecture; ziggurats, palaces, city planning; materials like mud brick; structural systems, decorative elements; socio-political influence, urban form, defensive planning characteristics.

Unit IV
Indus Valley civilization; town planning principles; grid patterns, drainage systems, standardized bricks; residential architecture; civic buildings; technological advancement and functional planning concepts.

Unit V
Ancient Greek architecture; orders, temples, public spaces; proportion systems, aesthetics; construction methods; relationship between architecture, philosophy, and democracy; influence on later architectural traditions.

Text Books

1. Fletcher, B. (2019). *A history of architecture*. Architectural Press.
2. Kostof, S. (2017). *A history of architecture*. Oxford University Press.
3. Trachtenberg, M., & Hyman, I. (2018). *Architecture from prehistory to postmodernity*. Pearson.
4. Watkin, D. (2016). *A history of western architecture*. Laurence King.
5. Banister, F. (2015). *Global history of architecture*. Wiley.

Reference Books

1. Ching, F. D. K. (2015). *A visual dictionary of architecture*. Wiley.
2. Curtis, W. (2019). *Modern architecture since 1900*. Phaidon.
3. Roth, L. M. (2018). *Understanding architecture*. Westview Press.
4. Kostof, S. (2016). *The city shaped*. Thames & Hudson.
5. Unwin, S. (2014). *Analysing architecture*. Routledge.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Mathematics & Geometry for Architecture

Course Category: Basic Science Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Apply mathematical concepts to architectural problems
2. Understand geometric principles in design
3. Develop analytical thinking for spatial applications
4. Support structural and design studies
5. Enhance precision in architectural representation

Course Outcomes
CO1 Application of geometry in architectural design
CO2 Use of mathematical tools for spatial analysis
CO3 Understanding proportions and transformations
CO4 Analytical problem-solving ability
CO5 Integration of mathematics with architectural thinking

Detailed Syllabus

Unit I
Basic mathematics for architecture; numbers, ratios, proportions; linear equations; practical applications in scaling, measurement, dimensional coordination; numerical accuracy in architectural drawings and layouts.

Unit II
Plane geometry; points, lines, angles, polygons; properties and constructions; geometric relationships; application in plans, elevations, and architectural compositions.

Unit III
Solid geometry; polyhedra, prisms, pyramids, cylinders, cones, spheres; surface area, volume calculations; relevance to spatial enclosure, massing, and volumetric analysis.

Unit IV
Coordinate geometry; Cartesian system, plotting points, lines, curves; slope, distance; applications in site planning, layout design, and spatial organization.

Unit V
Transformational geometry; symmetry, reflection, rotation, translation, scaling; mathematical basis of patterns, tessellations; application in architectural form generation and design logic.

Text Books

1. Venkatachala, K. N. (2018). *Engineering mathematics*. Oxford University Press.
2. Bansal, R. K. (2017). *Higher engineering mathematics*. Laxmi Publications.
3. Ching, F. D. K. (2015). *Architecture: form, space and order*. Wiley.
4. Adam, R. (2016). *Mathematics for architects*. Routledge.
5. Williams, K. (2014). *Geometry in architecture*. Wiley.

Reference Books

1. Salingaros, N. (2018). *Principles of urban structure*. Techne Press.
2. Livio, M. (2017). *The golden ratio*. Broadway Books.
3. Stewart, I. (2016). *Concepts of modern mathematics*. Dover.
4. Hambly, E. (2015). *Structural analysis*. Butterworths.
5. Thompson, D. (2014). *On growth and form*. Cambridge University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Communication Skills & Professional English

Course Category: Humanities & Management Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Improve professional communication skills
2. Develop technical vocabulary and clarity
3. Enhance presentation and interpersonal skills
4. Support academic and professional writing
5. Build confidence in spoken English

Course Outcomes
CO1 Effective oral communication
CO2 Professional writing ability
CO3 Improved listening and comprehension
CO4 Presentation and interview skills
CO5 Workplace communication readiness

Detailed Syllabus

Unit I
Fundamentals of communication; process, barriers; verbal and non-verbal communication; relevance in academic and professional architectural contexts.

Unit II
Listening and speaking skills; pronunciation, articulation; formal and informal speech; group discussions; professional interaction scenarios.

Unit III
Reading skills; comprehension strategies; technical texts; vocabulary building; contextual understanding for architectural literature.

Unit IV
Writing skills; sentence structure, paragraphs; technical writing basics; emails, reports; clarity, coherence, professional tone.

Unit V
Presentation skills; public speaking; visual aids; interviews; professional etiquette; confidence building in academic and workplace environments.

Text Books

1. Raman, M., & Sharma, S. (2018). *Technical communication*. Oxford University Press.
2. Meenakshi, R. (2017). *Communication skills*. Cambridge University Press.

3. Eastwood, J. (2016). *Oxford practice grammar*. Oxford University Press.
4. Bhatia, V. (2015). *Professional communication*. Pearson.
5. Murphy, R. (2019). *English grammar in use*. Cambridge University Press.

Reference Books

1. Swan, M. (2016). *Practical English usage*. Oxford University Press.
2. Bailey, S. (2018). *Academic writing*. Routledge.
3. Guffey, M. (2017). *Business communication*. Cengage.
4. Carter, R. (2015). *Vocabulary*. Routledge.
5. Wood, J. (2019). *Communication in our lives*. Cengage.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Site Visit / Orientation Studio

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Introduce students to real-world architectural environments
2. Develop observation and documentation skills
3. Understand site context and constraints
4. Relate theory to practice
5. Build professional exposure at entry level

Course Outcomes
CO1 Site observation and analysis skills
CO2 Documentation of built environments
CO3 Understanding of construction context
CO4 Professional awareness
CO5 Reflective learning ability

Guidelines
Structured site visits to construction sites, architectural projects, and institutional buildings; supervised documentation; sketches, notes, photographs; reflective reports.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER II

Architectural Design Studio – II

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Strengthen architectural design skills through contextual problems
2. Develop understanding of form, space, and function relationships
3. Introduce basic site response and climate considerations
4. Enhance design development through drawings and models
5. Build confidence in architectural critique and presentation

Course Outcomes
CO1 Contextual design response capability
CO2 Application of functional planning principles
CO3 Integration of form, space, and circulation
CO4 Development of design through drawings and models
CO5 Effective design communication and presentation

List of Exercises / Studio Tasks

1. Analysis of simple site conditions including orientation, access, and surroundings using diagrams, sketches, and basic site models.
2. Design of small-scale residential or institutional buildings emphasizing functional zoning, circulation, and spatial hierarchy.
3. Climate-responsive design exercises focusing on sun path, ventilation, shading, and basic environmental considerations.
4. Development of plans, sections, and elevations with appropriate scale, proportion, and architectural expression.
5. Exploration of built form through massing models highlighting solids, voids, and spatial sequencing.
6. Integration of basic structural logic and material considerations in design proposals.
7. Study of precedent buildings to derive functional and spatial lessons applicable to studio projects.
8. Iterative design refinement based on critiques, reviews, and peer discussions.
9. Preparation of presentation drawings and physical models for jury evaluation.

10. Final design jury emphasizing conceptual clarity, contextual response, and presentation quality.

Expected Outcomes
Contextual design ability, functional planning skills, climate awareness, presentation competence

Evaluation Scheme
Continuous Studio Assessment (100%)

Architectural Graphics & Drafting

Course Category: Engineering Science Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop proficiency in architectural drafting techniques
2. Understand conventions and standards of architectural drawings
3. Improve precision and accuracy in manual drafting
4. Introduce scaled drawing and dimensioning practices
5. Support studio and construction documentation needs

Course Outcomes
CO1 Accurate preparation of architectural drawings
CO2 Application of drafting standards and conventions
CO3 Proficiency in scaled plans, sections, and elevations
CO4 Effective dimensioning and annotation
CO5 Integration of graphics with design communication

List of Exercises

1. Practice of line types, lettering styles, and sheet composition using architectural drafting instruments and standards.
2. Preparation of scaled plans of simple spaces applying correct proportions, symbols, and dimensioning techniques.
3. Drafting of elevations and sections derived from given plans emphasizing alignment and accuracy.
4. Drawing of doors, windows, and staircases using standard architectural conventions and detailing norms.
5. Preparation of site plans indicating plot boundaries, setbacks, access, and basic landscaping elements.

6. Practice of dimensioning, annotation, and title block preparation for architectural drawings.
7. Development of working drawings for small residential units including plans, elevations, and sections.
8. Interpretation and redrawing of given architectural drawings to improve reading and drafting skills.
9. Application of hatching, textures, and line weights for clarity and visual hierarchy.
10. Compilation of a drafting portfolio demonstrating accuracy, consistency, and presentation quality.

Expected Outcomes
Drafting accuracy, drawing clarity, technical graphic competence

Evaluation Scheme
Continuous Assessment (100%)

Building Construction – I

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce basic building construction principles
2. Understand components of simple buildings
3. Relate materials to construction methods
4. Develop construction detailing skills
5. Support design studio and materials studies

Course Outcomes
CO1 Understanding of basic building components
CO2 Knowledge of construction techniques
CO3 Ability to read and prepare construction drawings
CO4 Application of materials in construction details
CO5 Foundation for advanced construction studies

Detailed Syllabus

Unit I
Introduction to building construction; functional requirements of buildings; building components; site preparation, setting out; tools and equipment; safety practices; role of construction drawings and specifications in architectural projects.

Unit II
Foundations; types of foundations, shallow and deep; bearing capacity considerations; foundation materials; simple footing construction; damp proof course; relevance to soil conditions and structural safety.

Unit III
Walls; load bearing and non load bearing walls; masonry types; brick and block bonding patterns; wall thickness considerations; openings; lintels and sills; construction practices and detailing.

Unit IV
Floors; ground floors and upper floors; flooring materials; construction methods for concrete and timber floors; finishes; functional requirements; durability and maintenance considerations.

Unit V
Roofs; flat and pitched roofs; roof coverings; trusses; rainwater disposal systems; construction details; functional requirements; climatic response and material selection.

Text Books

1. Rangwala, S. C. (2020). *Building construction*. Charotar Publishing House.
2. Arora, S. P., & Bindra, S. P. (2019). *Building construction*. Dhanpat Rai Publishing.
3. McKay, W. B. (2015). *Building construction*. Longman.
4. Barry, R. (2016). *The construction of buildings*. Blackwell.
5. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.

Reference Books

1. Varghese, P. C. (2017). *Building construction*. PHI Learning.
2. Rangwala, S. C. (2018). *Building construction drawings*. Charotar Publishing House.
3. Foster, J. (2016). *Structure and fabric*. Longman.
4. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.
5. Arora, K. (2015). *Practical building construction*. Standard Publishers.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

History of Architecture – II

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Study architectural developments in classical and medieval periods
2. Understand stylistic evolution and construction systems
3. Relate architecture to cultural and religious contexts
4. Develop comparative historical analysis skills
5. Strengthen architectural vocabulary and interpretation

Course Outcomes
CO1 Knowledge of classical architectural styles
CO2 Understanding of structural and spatial systems
CO3 Comparative analysis of historical periods
CO4 Interpretation of architectural elements and symbolism
CO5 Appreciation of architectural heritage continuity

Detailed Syllabus

Unit I
Ancient Roman architecture; planning principles, materials, construction systems; arches, vaults, domes; public buildings, infrastructure; influence on urban form and architectural legacy.

Unit II
Early Christian architecture; basilica form, planning, symbolism; construction techniques; transition from Roman traditions; spatial organization and liturgical requirements.

Unit III
Byzantine architecture; central planning, domes, pendentives; Hagia Sophia; decorative systems; symbolism, spatial experience, structural innovation.

Unit IV
Romanesque architecture; churches, monasteries; thick walls, rounded arches, vaults; structural systems; regional variations and defensive character.

Unit V
Gothic architecture; pointed arches, ribbed vaults, flying buttresses; cathedrals; verticality, light, stained glass; structural expression and spatial drama.

Text Books

1. Fletcher, B. (2019). *A history of architecture*. Architectural Press.
2. Kostof, S. (2017). *A history of architecture*. Oxford University Press.

3. Trachtenberg, M., & Hyman, I. (2018). *Architecture from prehistory to postmodernity*. Pearson.
4. Watkin, D. (2016). *A history of western architecture*. Laurence King.
5. Banister, F. (2015). *Global history of architecture*. Wiley.

Reference Books

1. Ching, F. D. K. (2015). *A visual dictionary of architecture*. Wiley.
2. Curtis, W. (2019). *Modern architecture since 1900*. Phaidon.
3. Roth, L. M. (2018). *Understanding architecture*. Westview Press.
4. Unwin, S. (2014). *Analysing architecture*. Routledge.
5. Kostof, S. (2016). *The city shaped*. Thames & Hudson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Environmental Science & Ecology

Course Category: Basic Science Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce environmental science principles
2. Understand ecosystems and ecological balance
3. Relate environmental issues to built environment
4. Develop sustainability awareness
5. Encourage responsible environmental practices

Course Outcomes
CO1 Understanding of ecological systems
CO2 Awareness of environmental challenges
CO3 Application of sustainability concepts
CO4 Evaluation of human environmental impact
CO5 Environmental responsibility in professional practice

Detailed Syllabus

Unit I
Environmental science overview; ecosystems, biotic and abiotic components; energy flow; ecological balance; relevance to human settlements and built environments.

Unit II
Natural resources; renewable and non renewable resources; water, forest, mineral resources; conservation strategies; sustainable utilization approaches.

Unit III
Environmental pollution; air, water, soil, noise pollution; sources, effects; control measures; relevance to urban and building environments.

Unit IV
Biodiversity and conservation; genetic, species, ecosystem diversity; threats; conservation methods; role of planners and architects in biodiversity protection.

Unit V
Environmental issues and sustainability; climate change, global warming; waste management; environmental ethics; sustainable development principles.

Text Books

1. Cunningham, W. (2018). *Environmental science*. McGraw-Hill.
2. Miller, G. T. (2017). *Environmental science*. Cengage.
3. Rajagopalan, R. (2016). *Environmental studies*. Oxford University Press.
4. Sharma, P. D. (2015). *Ecology and environment*. Rastogi Publications.
5. Bharucha, E. (2019). *Environmental studies*. Universities Press.

Reference Books

1. Carson, R. (2014). *Silent spring*. Houghton Mifflin.
2. Odum, E. (2016). *Fundamentals of ecology*. Brooks Cole.
3. Meadows, D. (2018). *Limits to growth*. Chelsea Green.
4. UNEP. (2019). *Global environment outlook*. United Nations.
5. World Bank. (2020). *Environmental sustainability*. World Bank Publications.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Design Thinking & Creativity

Course Category: Humanities & Management Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Introduce design thinking methodologies

2. Enhance creative problem solving skills
3. Develop user-centered design perspective
4. Encourage innovation in design process
5. Support studio-based learning approaches

Course Outcomes
CO1 Understanding of design thinking process
CO2 Creative ideation skills
CO3 User-centric problem analysis
CO4 Application of innovation techniques
CO5 Collaborative design mindset

Detailed Syllabus

Unit I
Design thinking concepts; creativity, innovation; stages of design thinking; relevance to architecture and design disciplines.

Unit II
Problem identification; empathy, observation; user needs; framing design challenges; context analysis.

Unit III
Ideation techniques; brainstorming, mind mapping; divergent thinking; concept generation methods.

Unit IV
Prototyping; models, mockups; iterative development; testing and feedback integration.

Unit V
Creative collaboration; teamwork; interdisciplinary approaches; reflection; application in architectural studios.

Text Books

1. Brown, T. (2019). *Change by design*. Harper Business.
2. Kelley, T. (2018). *The art of innovation*. Profile Books.
3. Cross, N. (2017). *Design thinking*. Bloomsbury.
4. Lidwell, W. (2016). *Universal principles of design*. Rockport.
5. Plattner, H. (2015). *Design thinking research*. Springer.

Reference Books

1. Lawson, B. (2018). *How designers think*. Routledge.
2. Michalko, M. (2017). *Thinkertoys*. Ten Speed Press.

3. Kelley, D. (2019). *Creative confidence*. Crown.
4. IDEO. (2016). *The field guide to human-centered design*. IDEO.
5. Norman, D. (2015). *The design of everyday things*. Basic Books.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship / Field Orientation

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide exposure to field and professional environments
2. Develop observation and documentation skills
3. Understand construction and office practices
4. Relate academic learning to real-world contexts
5. Build professional discipline and ethics

Course Outcomes
CO1 Field exposure and practical awareness
CO2 Documentation and reporting skills
CO3 Understanding of professional practices
CO4 Application of theoretical knowledge
CO5 Professional attitude development

Guidelines
Short-term field attachment with architectural offices, construction sites, or related organizations; supervised documentation; reports and presentations.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER III

Architectural Design Studio – III

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Develop intermediate architectural design competency
2. Integrate functional planning with structural logic
3. Introduce contextual and climatic responsiveness
4. Strengthen design development and detailing skills
5. Enhance critical thinking and design communication

Course Outcomes
CO1 Context-responsive architectural design ability
CO2 Integration of planning, structure, and form
CO3 Application of climate and site considerations
CO4 Development of coherent architectural proposals
CO5 Professional presentation and critique skills

List of Exercises / Studio Tasks

1. Analysis of contextual parameters including climate, access, surroundings, and regulations using diagrams, sketches, and analytical drawings.
2. Design of medium-scale institutional or community buildings emphasizing functional zoning, circulation, and spatial hierarchy.
3. Integration of basic structural systems and material logic into architectural design proposals.
4. Climate-responsive planning incorporating orientation, shading, ventilation, and passive design strategies.
5. Preparation of detailed plans, sections, elevations, and site layouts at appropriate architectural scales.
6. Development of massing models exploring volumetric relationships, solids, voids, and spatial sequencing.
7. Study and abstraction of architectural precedents relevant to the studio project typology.
8. Iterative design refinement through critiques, reviews, and peer discussions.

9. Preparation of presentation drawings, physical models, and design documentation.
10. Final jury presentation emphasizing conceptual clarity, contextual response, and technical integration.

Expected Outcomes
Intermediate design proficiency, contextual awareness, structural integration, professional presentation

Evaluation Scheme
Continuous Studio Assessment (100%)

Building Materials – II

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand advanced building materials and systems
2. Relate material performance to architectural applications
3. Introduce modern and composite materials
4. Develop material selection awareness
5. Support construction and design integration

Course Outcomes
CO1 Identification of advanced building materials
CO2 Understanding material behavior and performance
CO3 Application of materials in architectural systems
CO4 Evaluation of durability and sustainability
CO5 Informed material selection in design

Detailed Syllabus

Unit I
Concrete materials; cement types, admixtures, aggregates; concrete properties, workability, strength; special concretes, lightweight, high strength, fiber reinforced; applications in building components, durability considerations, quality control practices.

Unit II
Metals in construction; ferrous and non ferrous metals; steel production, properties, sections; corrosion, protection methods; aluminum, copper, alloys; applications in structures, cladding, joinery, architectural detailing.

Unit III
Glass and glazing materials; manufacturing processes; properties, strength, transparency;

types, float, tempered, laminated, insulated; glazing systems; applications in facades, openings, daylighting, thermal and acoustic considerations.

Unit IV
Plastics and polymers; thermoplastics, thermosetting plastics; properties, manufacturing; PVC, acrylics, polycarbonates; applications in buildings; advantages, limitations, environmental and sustainability aspects.

Unit V
Finishing materials; paints, varnishes, distempers; tiles, ceramics, stone finishes; flooring and wall finishes; properties, application methods; performance, maintenance, aesthetic considerations in architectural spaces.

Text Books

1. Arora, S. P., & Bindra, S. P. (2019). *Building materials and construction*. Dhanpat Rai Publishing.
2. Duggal, S. K. (2018). *Building materials*. New Age International.
3. Varghese, P. C. (2017). *Building materials*. PHI Learning.
4. Ashby, M. (2018). *Materials for architects and builders*. Butterworth-Heinemann.
5. Rangwala, S. C. (2020). *Engineering materials*. Charotar Publishing House.

Reference Books

1. Neville, A. M. (2019). *Properties of concrete*. Pearson.
2. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
3. Barry, R. (2016). *The construction of buildings*. Blackwell.
4. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.
5. Foster, J. (2016). *Structure and fabric*. Longman.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Building Construction – II

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Study advanced building construction components
2. Understand vertical circulation and enclosure systems

3. Develop construction detailing skills
4. Integrate materials with construction methods
5. Support studio and professional practice

Course Outcomes
CO1 Knowledge of advanced construction systems
CO2 Ability to detail building components
CO3 Understanding of enclosure and circulation elements
CO4 Application of construction logic in design
CO5 Preparation for professional documentation

Detailed Syllabus

Unit I
Doors and windows; timber, steel, aluminum types; fixing methods; shutters, frames, hardware; construction details; functional, aesthetic, security, and climatic considerations in architectural applications.

Unit II
Staircases; types, components, proportions; materials; RCC, steel, timber stairs; construction details; building regulations; safety, accessibility, and functional requirements.

Unit III
Roof coverings and waterproofing; flat roof treatments; waterproofing materials, methods; drainage details; thermal protection; construction practices and performance considerations.

Unit IV
Partitions and wall systems; brick, block, gypsum, panel partitions; construction techniques; acoustic and fire considerations; flexibility and interior space planning.

Unit V
Finishes and fittings; flooring, wall finishes, ceilings; fixing methods; service integration; detailing for durability, maintenance, and architectural quality.

Text Books

1. Rangwala, S. C. (2020). *Building construction*. Charotar Publishing House.
2. Arora, S. P., & Bindra, S. P. (2019). *Building construction*. Dhanpat Rai Publishing.
3. McKay, W. B. (2015). *Building construction*. Longman.
4. Barry, R. (2016). *The construction of buildings*. Blackwell.
5. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.

Reference Books

1. Varghese, P. C. (2017). *Building construction*. PHI Learning.

2. Foster, J. (2016). *Structure and fabric*. Longman.
3. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
4. Rangwala, S. C. (2018). *Building construction drawings*. Charotar Publishing House.
5. Arora, K. (2015). *Practical building construction*. Standard Publishers.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Structural Mechanics for Architects

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce fundamentals of structural mechanics
2. Develop understanding of forces and equilibrium
3. Relate structural behavior to architectural design
4. Build foundation for structural design studies
5. Enhance analytical skills for architects

Course Outcomes
CO1 Understanding of basic structural principles
CO2 Analysis of simple structural systems
CO3 Interpretation of force flow in buildings
CO4 Application of mechanics in design decisions
CO5 Preparedness for advanced structural courses

Detailed Syllabus

Unit I
Structural systems overview; loads, dead, live, wind; forces, moments; equilibrium concepts; free body diagrams; relevance of structural mechanics in architectural design decisions.

Unit II
Stress and strain; material behavior; elastic properties; Hooke law; axial members; deformation; applications in columns, ties, and structural components.

Unit III
Bending and shear; beams under loads; bending moment, shear force concepts; simple calculations; qualitative understanding of beam behavior in buildings.

Unit IV
Torsion and stability; torsional effects; columns, buckling concepts; slenderness; stability considerations in architectural structures.

Unit V
Structural form and efficiency; arches, trusses, frames; load paths; structural logic; relationship between form, material, and structural performance.

Text Books

1. Hibbeler, R. C. (2018). *Engineering mechanics*. Pearson.
2. Bansal, R. K. (2017). *Strength of materials*. Laxmi Publications.
3. Megson, T. H. G. (2019). *Structural and stress analysis*. Butterworth-Heinemann.
4. Gordon, J. E. (2016). *Structures*. Penguin.
5. Ambrose, J. (2015). *Simplified engineering for architects*. Wiley.

Reference Books

1. Ching, F. D. K. (2015). *Building structures illustrated*. Wiley.
2. Salvadori, M. (2017). *Why buildings stand up*. Norton.
3. Engel, H. (2018). *Structure systems*. Hatje Cantz.
4. Allen, E. (2016). *How buildings work*. Oxford University Press.
5. Schodek, D. (2014). *Structures*. Pearson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

History of Architecture – III

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Study architectural developments in Asian traditions
2. Understand indigenous construction systems
3. Relate culture and climate to built forms
4. Develop comparative historical understanding
5. Strengthen architectural heritage awareness

Course Outcomes
CO1 Knowledge of Asian architectural traditions
CO2 Understanding of indigenous building systems
CO3 Comparative historical analysis skills
CO4 Cultural interpretation of architecture
CO5 Appreciation of regional architectural heritage

Detailed Syllabus

Unit I
Indian architecture overview; climatic, cultural influences; materials, construction methods; evolution of forms across regions and periods.

Unit II
Ancient Indian architecture; rock cut architecture, stupas, temples; planning principles; symbolism; construction techniques.

Unit III
Temple architecture; Nagara, Dravidian, Vesara styles; spatial organization; structural systems; ornamentation.

Unit IV
Indo Islamic architecture; mosques, tombs; arches, domes; materials; synthesis of traditions.

Unit V
East Asian architecture; Chinese and Japanese traditions; timber construction; spatial concepts; relationship with nature.

Text Books

1. Brown, P. (2019). *Indian architecture*. Taraporevala.
2. Fletcher, B. (2019). *A history of architecture*. Architectural Press.
3. Kostof, S. (2017). *A history of architecture*. Oxford University Press.
4. Grover, S. (2018). *The architecture of India*. Vikas.
5. Michell, G. (2016). *The Hindu temple*. University of Chicago Press.

Reference Books

1. Ching, F. D. K. (2015). *A visual dictionary of architecture*. Wiley.
2. Tillotson, G. (2017). *Paradigms of Indian architecture*. Routledge.
3. Curtis, W. (2019). *Modern architecture since 1900*. Phaidon.
4. Unwin, S. (2014). *Analysing architecture*. Routledge.
5. Kostof, S. (2016). *The city shaped*. Thames & Hudson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Computer Applications in Architecture – I

Course Category: Engineering Science Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce computer applications in architecture
2. Develop basic CAD proficiency
3. Support drafting and design documentation
4. Improve digital visualization skills
5. Integrate digital tools with studio work

Course Outcomes
CO1 Basic computer aided drafting skills
CO2 Preparation of digital architectural drawings
CO3 Understanding of CAD conventions
CO4 Application of digital tools in design
CO5 Digital workflow awareness

List of Experiments / Exercises

1. Introduction to CAD interface, coordinate systems, drawing setup, units, layers, and basic drafting commands for architectural drawings.
2. Preparation of simple plans using line, polyline, offset, trim, and extend commands with proper layer management.
3. Drafting of elevations and sections derived from given plans using accurate scaling and alignment techniques.
4. Application of text, dimensions, and annotations following architectural drawing standards.
5. Creation of blocks for doors, windows, and furniture with insertion and modification techniques.
6. Preparation of site plans including plot boundaries, setbacks, and basic annotations.
7. Layout setup, viewport creation, and plotting of drawings at appropriate scales.
8. Introduction to basic 3D visualization using simple extrusion and viewing commands.
9. Editing and modification of drawings incorporating design changes and revisions.

10. Compilation of a digital drawing portfolio demonstrating accuracy and presentation quality.

Expected Outcomes
CAD proficiency, digital drafting competence, workflow understanding

Evaluation Scheme
Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Provide continued professional exposure
2. Develop understanding of office and site practices
3. Enhance documentation and reporting skills
4. Relate academic knowledge to practice
5. Build professional discipline

Course Outcomes
CO1 Practical exposure to architectural practice
CO2 Documentation and reporting ability
CO3 Understanding of construction and office workflow
CO4 Application of academic concepts
CO5 Professional attitude development

Guidelines
Supervised internship with architectural offices or construction organizations; structured tasks; documentation; report submission.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IV

Architectural Design Studio – IV

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Develop advanced architectural design capability
2. Integrate structure, services, and climate into design
3. Address urban and site-responsive design parameters
4. Strengthen detailing and technical resolution skills
5. Enhance professional presentation and jury competence

Course Outcomes
CO1 Complex architectural problem-solving ability
CO2 Integration of building systems in design
CO3 Contextual and climatic responsiveness
CO4 Detailed architectural development proficiency
CO5 Professional communication and presentation skills

List of Exercises / Studio Tasks

1. Site analysis incorporating physical, social, climatic, and regulatory parameters using analytical drawings and models.
2. Design of complex institutional or mixed-use buildings emphasizing zoning, circulation, and functional integration.
3. Integration of structural grids, service cores, and environmental strategies within architectural proposals.
4. Development of detailed plans, sections, elevations, and site layouts at multiple architectural scales.
5. Preparation of area statements, circulation diagrams, and conceptual structural layouts.
6. Climate-responsive design strategies addressing daylight, ventilation, shading, and thermal comfort.
7. Preparation of detailed design drawings highlighting building components and spatial articulation.
8. Iterative refinement through reviews, critiques, and technical discussions.

9. Preparation of comprehensive presentation drawings, physical models, and digital visuals.
10. Final design jury focusing on concept clarity, technical integration, and architectural expression.

Expected Outcomes
Advanced design competence, systems integration, professional-level presentation

Evaluation Scheme
Continuous Studio Assessment (100%)

Building Services – I (Water Supply & Sanitation)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fundamentals of water supply systems
2. Introduce sanitation and drainage principles
3. Relate services design to building planning
4. Develop coordination awareness with architecture
5. Promote hygienic and sustainable systems

Course Outcomes
CO1 Knowledge of water supply systems
CO2 Understanding of sanitation and drainage
CO3 Integration of services in building design
CO4 Awareness of codes and standards
CO5 Sustainable services planning ability

Detailed Syllabus

Unit I
Water supply fundamentals; water demand, sources, quality standards; surface and groundwater sources; intake structures; treatment principles; relevance of potable water planning in residential and institutional buildings.

Unit II
Water distribution systems; gravity, pumping systems; storage tanks, overhead and underground tanks; pipe materials, joints; layout principles; pressure considerations; integration with building planning.

Unit III
Plumbing systems; internal water supply layouts; fixtures and fittings; hot and cold water systems; sizing of pipes; basic design principles for efficient and hygienic supply.

Unit IV
Sanitation systems; sewage characteristics; sewerage systems; house drainage; traps, vents; inspection chambers; principles of wastewater disposal and treatment relevance.

Unit V
Sustainable water management; rainwater harvesting; greywater reuse; water conservation techniques; building-level strategies; environmental and regulatory considerations.

Text Books

1. Rangwala, S. C. (2020). *Building services*. Charotar Publishing House.
2. Arora, S. P., & Bindra, S. P. (2019). *Building services*. Dhanpat Rai Publishing.
3. McKay, W. B. (2015). *Building services*. Longman.
4. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
5. Varghese, P. C. (2017). *Building construction*. PHI Learning.

Reference Books

1. NBC. (2016). *National building code of India*. BIS.
2. Barry, R. (2016). *The construction of buildings*. Blackwell.
3. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.
4. Foster, J. (2016). *Structure and fabric*. Longman.
5. CPHEEO. (2018). *Manual on water supply*. Government of India.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Structural Design – I (RCC Basics)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce reinforced concrete principles
2. Understand behavior of RCC elements
3. Apply basic design concepts
4. Relate structural design to architecture

5. Prepare for advanced structural courses

Course Outcomes
CO1 Understanding of RCC fundamentals
CO2 Analysis of basic RCC members
CO3 Awareness of design philosophy
CO4 Integration of RCC systems in buildings
CO5 Structural coordination capability

Detailed Syllabus

Unit I
Introduction to reinforced concrete; properties of concrete and steel; stress strain behavior; working stress and limit state concepts; role of RCC in architectural structures.

Unit II
Design philosophy; loads, load combinations; limit state method; safety factors; basic design assumptions; relevance to building structures.

Unit III
RCC beams; bending behavior; singly reinforced beams; basic design procedure; detailing principles; architectural integration considerations.

Unit IV
RCC slabs; one way and two way slabs; load distribution; span depth ratios; reinforcement detailing; functional and spatial implications.

Unit V
RCC columns and footings; axial load behavior; short columns; isolated footings; basic design concepts; coordination with architectural layouts.

Text Books

1. Pillai, S. U., & Menon, D. (2017). *Reinforced concrete design*. Tata McGraw-Hill.
2. Varghese, P. C. (2018). *Design of reinforced concrete structures*. PHI Learning.
3. Bansal, R. K. (2017). *Strength of materials*. Laxmi Publications.
4. Hibbeler, R. C. (2018). *Engineering mechanics*. Pearson.
5. Ambrose, J. (2015). *Simplified engineering for architects*. Wiley.

Reference Books

1. IS 456. (2000). *Plain and reinforced concrete code*. BIS.
2. Schodek, D. (2014). *Structures*. Pearson.
3. Salvadori, M. (2017). *Why buildings stand up*. Norton.
4. Ching, F. D. K. (2015). *Building structures illustrated*. Wiley.

5. Allen, E. (2016). *How buildings work*. Oxford University Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Climatology & Building Physics

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand climate and environmental parameters
2. Study heat, light, and sound behavior
3. Relate climate to building design
4. Promote passive design strategies
5. Support sustainable architecture

Course Outcomes
CO1 Understanding of climatic elements
CO2 Application of climate-responsive design
CO3 Awareness of thermal comfort principles
CO4 Integration of building physics in design
CO5 Sustainable design decision capability

Detailed Syllabus

Unit I
Climate and weather; macro and micro climate; temperature, humidity, wind, solar radiation; climatic classification; relevance to building design and planning.

Unit II
Thermal comfort; heat transfer modes; conduction, convection, radiation; comfort indices; building envelope response; passive thermal design concepts.

Unit III
Solar geometry; sun path diagrams; shading devices; orientation strategies; daylight availability; climatic response in architectural planning.

Unit IV
Lighting and acoustics fundamentals; natural lighting principles; glare control; basic acoustics concepts; sound propagation; relevance in building spaces.

Unit V
Climate responsive architecture; vernacular responses; passive cooling techniques; building materials and envelope design; sustainability considerations.

Text Books

1. Koenigsberger, O. (2017). *Manual of tropical housing*. Orient Blackswan.
2. Szokolay, S. (2014). *Introduction to architectural science*. Routledge.
3. Lechner, N. (2015). *Heating, cooling, lighting*. Wiley.
4. Givoni, B. (2016). *Climate considerations in building*. Wiley.
5. Watson, D. (2018). *Climatic design*. McGraw-Hill.

Reference Books

1. Olgyay, V. (2015). *Design with climate*. Princeton University Press.
2. ASHRAE. (2019). *Handbook of fundamentals*. ASHRAE.
3. Brown, G. (2016). *Sun, wind and light*. Wiley.
4. Hyde, R. (2018). *Climate responsive design*. Taylor & Francis.
5. Ratti, C. (2017). *Urban microclimate*. MIT Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Computer Applications in Architecture – II

Course Category: Engineering Science Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Advance computer aided architectural applications
2. Introduce 3D modeling concepts
3. Support visualization and presentation
4. Enhance digital workflow efficiency
5. Integrate computing with design studio

Course Outcomes
CO1 3D modeling proficiency
CO2 Digital visualization skills
CO3 Application of modeling tools in design
CO4 Workflow integration ability
CO5 Presentation quality enhancement

List of Experiments / Exercises

1. Introduction to 3D modeling interface, coordinate systems, view controls, and modeling environment setup.
2. Creation of basic 3D forms using extrusion, revolve, and boolean operations.
3. Development of simple building models from 2D drawings using accurate dimensions.
4. Application of materials and textures to 3D models for visualization.
5. Lighting setup and basic rendering techniques for architectural models.
6. Camera views and composition for presentation perspectives.
7. Editing and refinement of 3D models based on design changes.
8. Integration of site context and terrain modeling basics.
9. Preparation of rendered views for studio presentations.
10. Compilation of a digital 3D portfolio demonstrating modeling and visualization skills.

Expected Outcomes
3D modeling competence, visualization skills, digital integration

Evaluation Scheme
Continuous Assessment (100%)

Humanities Elective (Art / Cultural Studies)

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop cultural and artistic awareness
2. Understand relationship between art and architecture
3. Enhance critical and aesthetic thinking
4. Broaden interdisciplinary perspective
5. Support holistic architectural education

Course Outcomes
CO1 Cultural interpretation skills
CO2 Appreciation of art and heritage
CO3 Critical thinking development
CO4 Interdisciplinary awareness
CO5 Enhanced architectural sensitivity

Detailed Syllabus

Unit I
Introduction to art and culture; definitions; art forms; cultural expressions; relevance to architecture and built environment.

Unit II
Visual arts; painting, sculpture; materials, techniques; spatial expression; influence on architectural form.

Unit III
Performing arts and culture; music, dance, theatre; spatial requirements; cultural context and symbolism.

Unit IV
Cultural heritage; traditions, rituals; regional expressions; impact on settlement patterns and architecture.

Unit V
Art, culture, and contemporary architecture; public art; cultural sustainability; integration with architectural practice.

Text Books

1. Honour, H. (2016). *A world history of art*. Laurence King.
2. Kostof, S. (2017). *A history of architecture*. Oxford University Press.
3. Ching, F. D. K. (2015). *Architecture: form, space and order*. Wiley.
4. Tillotson, G. (2017). *Paradigms of Indian architecture*. Routledge.
5. Watkin, D. (2016). *A history of western architecture*. Laurence King.

Reference Books

1. Curtis, W. (2019). *Modern architecture since 1900*. Phaidon.
2. Banister, F. (2015). *Global history of architecture*. Wiley.
3. Unwin, S. (2014). *Analysing architecture*. Routledge.
4. Hall, S. (2016). *Cultural identity*. Sage.
5. Appadurai, A. (2015). *Modernity at large*. Minnesota Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Continue professional exposure
2. Strengthen understanding of construction practices
3. Enhance documentation skills
4. Relate academic learning to practice
5. Develop professional responsibility

Course Outcomes
CO1 Professional practice exposure
CO2 Construction process understanding
CO3 Documentation and reporting ability
CO4 Application of theoretical knowledge
CO5 Professional ethics awareness

Guidelines
Supervised internship with architectural or construction organizations; structured activities; documentation; report submission.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER V

Architectural Design Studio – V

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Address complex architectural problems at urban scale
2. Integrate structural, services, and environmental systems
3. Apply contextual, social, and regulatory parameters
4. Strengthen architectural detailing and resolution
5. Enhance professional studio communication skills

Course Outcomes
CO1 Urban-scale architectural design capability
CO2 Integration of multiple building systems
CO3 Contextual and regulatory responsiveness
CO4 Advanced design detailing proficiency
CO5 Professional-level design presentation

List of Exercises / Studio Tasks

1. Urban site analysis incorporating land use, access, circulation, climate, and regulatory controls using diagrams and analytical drawings.
2. Design of complex public or mixed-use buildings responding to urban context, density, and functional integration.
3. Integration of structural systems, service cores, and environmental strategies within architectural proposals.
4. Preparation of detailed plans, sections, elevations, and urban design layouts at appropriate scales.
5. Development of massing studies addressing skyline, urban form, and spatial hierarchy.
6. Preparation of area statements, circulation networks, and zoning diagrams.
7. Climate-responsive and sustainable design strategies integrated at building and site levels.
8. Iterative design refinement through technical reviews and design critiques.
9. Preparation of comprehensive presentation drawings, models, and digital visuals.

10. Final jury presentation emphasizing urban response, technical integration, and architectural expression.

Expected Outcomes
Urban design competence, systems integration, professional architectural presentation

Evaluation Scheme
Continuous Studio Assessment (100%)

Structural Design – II (Steel Structures)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of steel structural systems
2. Understand behavior of steel members and connections
3. Apply basic steel design concepts
4. Relate steel structures to architectural design
5. Prepare for advanced structural applications

Course Outcomes
CO1 Understanding of steel structural behavior
CO2 Identification of steel sections and systems
CO3 Awareness of basic steel design principles
CO4 Integration of steel structures in buildings
CO5 Structural coordination capability

Detailed Syllabus

Unit I
Structural steel materials; properties of steel; rolled steel sections; standard sections; mechanical behavior; advantages and limitations of steel structures in architectural applications and building systems.

Unit II
Steel connections; bolted and welded connections; connection components; load transfer mechanisms; detailing principles; relevance to constructability and architectural coordination.

Unit III
Tension members; behavior under axial loads; net and gross sections; basic design concepts; application in trusses and structural frameworks.

Unit IV
Compression members; columns, buckling behavior; slenderness ratio; basic design considerations; stability aspects in steel structures.

Unit V
Steel beams and frames; bending behavior; simple beam design concepts; portal frames; integration with architectural planning and building envelopes.

Text Books

1. Duggal, S. K. (2019). *Design of steel structures*. McGraw-Hill.
2. Negi, L. S. (2018). *Structural steel design*. Tata McGraw-Hill.
3. Subramanian, N. (2017). *Design of steel structures*. Oxford University Press.
4. Salmon, C. (2016). *Steel structures*. Pearson.
5. Ambrose, J. (2015). *Simplified engineering for architects*. Wiley.

Reference Books

1. IS 800. (2007). *General construction in steel*. BIS.
2. Schodek, D. (2014). *Structures*. Pearson.
3. Engel, H. (2018). *Structure systems*. Hatje Cantz.
4. Allen, E. (2016). *How buildings work*. Oxford University Press.
5. Ching, F. D. K. (2015). *Building structures illustrated*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Building Services – II (HVAC & Fire Safety)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand HVAC system principles
2. Introduce thermal comfort control methods
3. Study fire safety and protection systems
4. Integrate services with architectural planning
5. Promote safe and efficient building systems

Course Outcomes
CO1 Understanding of HVAC system components
CO2 Application of thermal comfort concepts
CO3 Awareness of fire safety systems
CO4 Integration of services in design
CO5 Compliance with safety regulations

Detailed Syllabus

Unit I
HVAC fundamentals; thermal comfort requirements; heat gains and losses; air conditioning principles; relevance of HVAC systems in different building types.

Unit II
Air conditioning systems; centralized and decentralized systems; components; air distribution; ducts; integration with architectural layouts.

Unit III
Ventilation systems; natural and mechanical ventilation; indoor air quality; exhaust systems; application in residential and commercial buildings.

Unit IV
Fire safety principles; fire behavior; fire load; fire prevention concepts; building fire safety planning and zoning.

Unit V
Fire protection systems; detection, alarm systems; sprinklers, hydrants; egress planning; coordination with building design and regulations.

Text Books

1. Arora, S. P., & Bindra, S. P. (2019). *Building services*. Dhanpat Rai Publishing.
2. McKay, W. B. (2015). *Building services*. Longman.
3. Rangwala, S. C. (2020). *Building services*. Charotar Publishing House.
4. ASHRAE. (2019). *HVAC fundamentals*. ASHRAE.
5. Foster, J. (2016). *Structure and fabric*. Longman.

Reference Books

1. NBC. (2016). *National building code of India*. BIS.
2. Barry, R. (2016). *The construction of buildings*. Blackwell.
3. Lechner, N. (2015). *Heating, cooling, lighting*. Wiley.
4. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.
5. CPWD. (2018). *Fire safety guidelines*. Government of India.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Urban Design Fundamentals

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of urban design
2. Understand urban form and structure
3. Relate buildings to public spaces
4. Develop urban analytical skills
5. Support studio and planning integration

Course Outcomes
CO1 Understanding of urban design principles
CO2 Analysis of urban form and spaces
CO3 Integration of buildings within urban context
CO4 Application of urban design tools
CO5 Awareness of public realm design

Detailed Syllabus

Unit I
Urban design introduction; scope, objectives; relationship between architecture and urbanism; urban elements; streets, blocks, plots, public spaces.

Unit II
Urban morphology; patterns of development; land use; density; scale; urban form analysis and interpretation.

Unit III
Public spaces; streets, squares, plazas; movement systems; pedestrian environments; social and cultural aspects.

Unit IV
Urban design theories; historic and contemporary approaches; imageability; legibility; urban character.

Unit V
Urban design process; site analysis; conceptual frameworks; urban design guidelines; integration with architectural projects.

Text Books

1. Shirvani, H. (2016). *The urban design process*. Van Nostrand Reinhold.
2. Lynch, K. (2015). *The image of the city*. MIT Press.
3. Moughtin, C. (2017). *Urban design*. Routledge.
4. Carmona, M. (2018). *Public places urban spaces*. Routledge.
5. Kostof, S. (2016). *The city shaped*. Thames & Hudson.

Reference Books

1. Jacobs, J. (2014). *The death and life of great American cities*. Vintage.
2. Bentley, I. (2015). *Responsive environments*. Architectural Press.
3. Trancik, R. (2016). *Finding lost space*. Wiley.
4. Gehl, J. (2017). *Life between buildings*. Island Press.
5. Hall, P. (2018). *Cities of tomorrow*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Building Economics & Costing

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce principles of building economics
2. Understand cost components in construction
3. Develop basic estimating skills
4. Relate cost to design decisions
5. Support professional practice requirements

Course Outcomes
CO1 Understanding of construction economics
CO2 Cost estimation capability
CO3 Awareness of budgeting principles
CO4 Integration of cost considerations in design
CO5 Professional practice preparedness

Detailed Syllabus

Unit I
Introduction to building economics; cost concepts; capital and running costs; life cycle costing; relevance in architectural projects.

Unit II
Estimation basics; types of estimates; approximate methods; plinth area, cubic content methods; applications.

Unit III
Detailed estimates; measurement methods; quantities for basic building components; abstract of costs.

Unit IV
Rate analysis; material, labor, overheads; factors affecting rates; basic principles of rate analysis.

Unit V
Cost control and management; budgeting; cost planning; value engineering; relationship between cost and design decisions.

Text Books

1. Rangwala, S. C. (2019). *Estimating and costing*. Charotar Publishing House.
2. Kharbanda, O. (2018). *Building economics*. McGraw-Hill.
3. Seeley, I. (2016). *Building economics*. Palgrave.
4. Arora, S. P., & Bindra, S. P. (2019). *Building construction*. Dhanpat Rai Publishing.
5. Ashworth, A. (2017). *Cost studies of buildings*. Routledge.

Reference Books

1. Ferry, D. (2015). *Cost planning of buildings*. Wiley.
2. Potts, K. (2016). *Construction cost management*. Routledge.
3. Brook, M. (2018). *Estimating and tendering*. Butterworth-Heinemann.
4. Ashworth, A. (2017). *Contractual procedures*. Pearson.
5. Willis, C. (2014). *Quantity surveying practice*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Elective I (Interior Design / Landscape Design)

Course Category: Professional Elective Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop specialized design knowledge
2. Understand interior or landscape systems
3. Enhance aesthetic and functional sensitivity
4. Support elective-based specialization
5. Broaden professional skill set

Course Outcomes
CO1 Specialized design understanding
CO2 Application of elective knowledge in design
CO3 Enhanced spatial sensitivity
CO4 Interdisciplinary awareness
CO5 Professional versatility

Detailed Syllabus

Unit I
Introduction to elective domain; scope, principles; relevance to architectural practice and design integration.

Unit II
Design elements and principles specific to interior or landscape contexts; materials; spatial organization.

Unit III
Functional planning; user requirements; circulation; environmental considerations.

Unit IV
Technical aspects; construction methods; detailing; coordination with architecture.

Unit V
Contemporary practices; sustainability; professional applications; case study orientation.

Text Books

1. Ching, F. D. K. (2015). *Interior design illustrated*. Wiley.
2. Booth, N. (2016). *Foundations of landscape architecture*. Wiley.
3. Kilmer, R. (2017). *Designing interiors*. Wiley.
4. Holden, R. (2018). *Landscape architecture*. Routledge.

5. Lawson, B. (2018). *How designers think*. Routledge.

Reference Books

1. Laurens, J. (2016). *The language of space*. Wiley.
2. Motloch, J. (2015). *Introduction to landscape design*. Wiley.
3. Pile, J. (2014). *Interior design*. Pearson.
4. Thompson, I. (2017). *Landscape architecture*. Routledge.
5. Bell, S. (2018). *Landscape design*. Routledge.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Strengthen professional exposure
2. Understand advanced construction practices
3. Enhance documentation and reporting skills
4. Relate studio learning to practice
5. Develop professional competence

Course Outcomes
CO1 Professional practice exposure
CO2 Advanced construction understanding
CO3 Documentation proficiency
CO4 Application of academic learning
CO5 Professional ethics development

Guidelines
Structured internship with architectural or construction organizations; supervised tasks; documentation; report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VI

Architectural Design Studio – VI

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Address advanced architectural problems with strong contextual grounding
2. Integrate sustainability, services, and structural systems comprehensively
3. Develop urban sensitivity and social responsiveness
4. Achieve higher levels of technical detailing and resolution
5. Strengthen professional studio presentation and critical evaluation skills

Course Outcomes
CO1 Advanced architectural problem-solving capability
CO2 Integrated application of building systems
CO3 Contextual, social, and environmental responsiveness
CO4 High-level design detailing proficiency
CO5 Professional design communication and critique skills

List of Exercises / Studio Tasks

1. Comprehensive site and urban context analysis including socio-cultural, climatic, infrastructural, and regulatory parameters using analytical drawings.
2. Design of complex institutional, public, or urban infill projects addressing multi-functional requirements and stakeholder needs.
3. Integration of sustainable strategies including passive design, material selection, and resource efficiency.
4. Coordination of structural systems, services, and circulation within architectural proposals.
5. Preparation of detailed drawings including plans, sections, elevations, and enlarged details.
6. Development of massing studies responding to urban form, skyline, and spatial hierarchy.
7. Preparation of design narratives, diagrams, and technical justifications.
8. Iterative refinement through technical reviews, critiques, and jury feedback.

9. Preparation of comprehensive presentation drawings, physical models, and digital visualizations.
10. Final jury presentation emphasizing conceptual clarity, sustainability, and technical integration.

Expected Outcomes
Advanced design maturity, integrated systems understanding, professional-level resolution

Evaluation Scheme
Continuous Studio Assessment (100%)

Sustainable Architecture & Green Buildings

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles of sustainable architecture
2. Introduce green building concepts and rating systems
3. Relate sustainability to building design and performance
4. Promote resource-efficient architectural solutions
5. Support climate-responsive and low-impact design approaches

Course Outcomes
CO1 Understanding of sustainability principles
CO2 Awareness of green building standards
CO3 Application of sustainable strategies in design
CO4 Evaluation of environmental performance
CO5 Responsible architectural decision-making

Detailed Syllabus

Unit I
Sustainable architecture concepts; environmental challenges; principles of sustainability; ecological footprint; relevance to built environment and architectural practice.

Unit II
Climate-responsive design strategies; passive heating and cooling; orientation; envelope design; material selection; energy-efficient planning approaches.

Unit III
Green building materials; renewable and recycled materials; embodied energy; life cycle assessment; material performance and sustainability evaluation.

Unit IV
Energy efficiency in buildings; lighting systems; HVAC optimization; renewable energy integration; solar, wind applications in buildings.

Unit V
Green building rating systems; LEED, GRIHA concepts; assessment criteria; sustainability metrics; regulatory and professional implications.

Text Books

1. Lechner, N. (2015). *Heating, cooling, lighting*. Wiley.
2. Kibert, C. (2016). *Sustainable construction*. Wiley.
3. Szokolay, S. (2014). *Introduction to architectural science*. Routledge.
4. Yeang, K. (2018). *Eco-design*. Wiley.
5. Givoni, B. (2016). *Climate considerations in building*. Wiley.

Reference Books

1. Olgyay, V. (2015). *Design with climate*. Princeton University Press.
2. ASHRAE. (2019). *Handbook of fundamentals*. ASHRAE.
3. Hyde, R. (2018). *Climate responsive design*. Taylor & Francis.
4. Edwards, B. (2014). *Rough guide to sustainability*. RIBA.
5. TERI. (2020). *GRIHA manual*. TERI Press.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Advanced Building Construction

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Study advanced construction technologies and systems
2. Understand high-rise and complex building construction
3. Develop advanced detailing and coordination skills
4. Integrate construction methods with design intent
5. Prepare for professional practice and execution

Course Outcomes
CO1 Knowledge of advanced construction systems
CO2 Ability to detail complex building components
CO3 Understanding of construction sequencing
CO4 Integration of technology with architectural design
CO5 Professional construction documentation capability

Detailed Syllabus

Unit I
Advanced foundations; pile foundations; raft foundations; construction methods; equipment; applicability in high-rise and complex structures.

Unit II
Framed structures; RCC and steel frames; construction sequencing; formwork systems; prefabrication concepts; quality control aspects.

Unit III
High-rise construction techniques; vertical transportation; curtain walls; cladding systems; construction logistics and safety considerations.

Unit IV
Special construction systems; precast construction; modular systems; composite structures; advantages, limitations, and applications.

Unit V
Construction management interfaces; coordination of services; construction detailing; execution challenges; role of architect during construction.

Text Books

1. Barry, R. (2016). *The construction of buildings*. Blackwell.
2. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.
3. Chudley, R., & Greeno, R. (2014). *Building construction handbook*. Routledge.
4. Rangwala, S. C. (2020). *Building construction*. Charotar Publishing House.
5. Foster, J. (2016). *Structure and fabric*. Longman.

Reference Books

1. Varghese, P. C. (2017). *Building construction*. PHI Learning.
2. McKay, W. B. (2015). *Building construction*. Longman.
3. IS Codes. (2018). *Construction practices*. BIS.
4. Peurifoy, R. (2016). *Construction planning*. McGraw-Hill.
5. Harris, F. (2017). *Modern construction management*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Acoustics & Lighting Design

Course Category: Engineering Science Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand fundamentals of architectural acoustics
2. Study natural and artificial lighting principles
3. Integrate acoustic and lighting design in buildings
4. Enhance comfort and performance of interior spaces
5. Support specialized design decision-making

Course Outcomes
CO1 Understanding of sound and light behavior
CO2 Application of acoustic design principles
CO3 Lighting design integration capability
CO4 Enhancement of user comfort and performance
CO5 Technical coordination skills

Detailed Syllabus

Unit I
Sound fundamentals; nature of sound; sound propagation; frequency; decibel scale; relevance of acoustics in architectural spaces.

Unit II
Architectural acoustics; room acoustics; reverberation; sound absorption; acoustic materials; design considerations for different building types.

Unit III
Noise control; sources of noise; noise criteria; sound insulation; vibration control; urban and building noise mitigation strategies.

Unit IV
Lighting fundamentals; nature of light; photometric quantities; daylight principles; glare control; daylight integration in buildings.

Unit V
Artificial lighting design; light sources; luminaires; lighting layouts; energy efficiency; integration with architectural and interior design.

Text Books

1. Everest, F. (2016). *Master handbook of acoustics*. McGraw-Hill.
2. Lechner, N. (2015). *Heating, cooling, lighting*. Wiley.
3. Hopkinson, R. (2014). *Lighting*. Architectural Press.
4. Long, M. (2018). *Architectural acoustics*. Elsevier.
5. Phillips. (2019). *Lighting manual*. Philips Lighting.

Reference Books

1. Egan, M. (2015). *Architectural acoustics*. McGraw-Hill.
2. ASHRAE. (2019). *Handbook of fundamentals*. ASHRAE.
3. Moore, J. (2016). *Design for daylighting*. Wiley.
4. Brown, G. (2016). *Sun, wind and light*. Wiley.
5. CIBSE. (2018). *Lighting guide*. CIBSE.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Practice – I

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce professional architectural practice framework
2. Understand roles and responsibilities of architects
3. Study office organization and workflows
4. Introduce ethics and professional conduct
5. Prepare for industry engagement

Course Outcomes
CO1 Understanding of architectural profession
CO2 Awareness of professional roles and responsibilities
CO3 Knowledge of office practices
CO4 Ethical and professional conduct awareness
CO5 Industry readiness

Detailed Syllabus

Unit I
Architectural profession overview; scope of practice; role of architect; professional organizations; regulatory framework in India.

Unit II
Office organization; types of practices; workflow; coordination with consultants; documentation procedures.

Unit III
Client architect relationship; stages of services; briefing; agreements; fee structures; professional responsibilities.

Unit IV
Building contracts; types of contracts; tendering procedures; bids; responsibilities during execution.

Unit V
Professional ethics; code of conduct; legal responsibilities; liability; contemporary professional challenges.

Text Books

1. Council of Architecture. (2017). *Architects act and regulations*. COA.
2. Roshan, R. (2018). *Professional practice*. CBS Publishers.
3. Rangwala, S. C. (2019). *Professional practice*. Charotar Publishing House.
4. Wakchaure, M. (2016). *Architectural practice*. McGraw-Hill.
5. Ching, F. D. K. (2015). *Building construction illustrated*. Wiley.

Reference Books

1. Hudson, J. (2016). *Architectural practice handbook*. RIBA.
2. Ashworth, A. (2017). *Contractual procedures*. Pearson.
3. Emmitt, S. (2018). *Architectural management*. Wiley.
4. Davis, M. (2015). *Ethics in architecture*. Routledge.
5. COA. (2020). *Professional guidelines*. COA.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Elective II (Housing / Vernacular Architecture)

Course Category: Professional Elective Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Develop understanding of specialized architectural domains
2. Study housing or vernacular architectural systems
3. Relate culture, climate, and construction
4. Enhance contextual design sensitivity
5. Support elective-based specialization

Course Outcomes
CO1 Knowledge of housing or vernacular systems
CO2 Contextual and cultural understanding
CO3 Application of elective knowledge in design
CO4 Sensitivity to climate and resources
CO5 Professional versatility

Detailed Syllabus

Unit I
Introduction to housing or vernacular architecture; scope; relevance; social and cultural context.

Unit II
Housing typologies or vernacular forms; spatial organization; materials; construction techniques.

Unit III
Climatic and environmental responses; passive strategies; sustainability aspects.

Unit IV
Policy, standards, and contemporary challenges; affordability; urban and rural contexts.

Unit V
Case studies; contemporary interpretations; integration with modern architectural practice.

Text Books

1. Moudon, A. (2017). *Public streets for public use*. Columbia University Press.
2. Oliver, P. (2016). *Dwellings*. Phaidon.
3. Turner, J. (2015). *Housing by people*. Marion Boyars.
4. Rapoport, A. (2018). *House form and culture*. Pearson.

5. Grover, S. (2018). *The architecture of India*. Vikas.

Reference Books

1. Jain, K. (2017). *Indian housing*. Oxford University Press.
2. Tillotson, G. (2017). *Paradigms of Indian architecture*. Routledge.
3. Curtis, W. (2019). *Modern architecture since 1900*. Phaidon.
4. Unwin, S. (2014). *Analysing architecture*. Routledge.
5. Steele, J. (2018). *Architecture for humanity*. Thames & Hudson.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Consolidate professional training exposure
2. Understand advanced office and site practices
3. Enhance technical documentation skills
4. Relate academic and studio learning to practice
5. Develop professional confidence

Course Outcomes
CO1 Advanced professional exposure
CO2 Understanding of integrated practice
CO3 Documentation and reporting proficiency
CO4 Application of academic knowledge
CO5 Professional competence development

Guidelines
Structured internship with architectural or construction organizations; supervised responsibilities; documentation; report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VII

Architectural Design Studio – VII

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Address large-scale urban and regional architectural problems
2. Integrate planning principles with architectural design
3. Incorporate regulatory, infrastructure, and sustainability frameworks
4. Develop comprehensive design resolution at urban scale
5. Strengthen professional design leadership and presentation

Course Outcomes
CO1 Urban and regional scale design capability
CO2 Integration of planning and architectural systems
CO3 Regulatory and infrastructure responsiveness
CO4 Advanced spatial and technical resolution
CO5 Professional leadership and communication skills

List of Exercises / Studio Tasks

1. Urban context analysis including land use, density, infrastructure, mobility, environment, and regulations using analytical maps and diagrams.
2. Design of urban-scale projects such as campuses, transit-oriented developments, or mixed-use precincts.
3. Integration of infrastructure systems including transportation, utilities, and public amenities within design proposals.
4. Development of master plans, zoning diagrams, and urban design frameworks.
5. Detailed architectural design of selected components within the larger urban proposal.
6. Integration of sustainability strategies at urban and building scales.
7. Preparation of phasing strategies, development controls, and design guidelines.
8. Iterative design refinement through expert reviews and critiques.
9. Preparation of comprehensive drawings, models, and digital simulations.
10. Final jury presentation emphasizing urban vision, technical rigor, and architectural quality.

Expected Outcomes
Urban-scale design proficiency, planning integration, professional-level architectural leadership

Evaluation Scheme
Continuous Studio Assessment (100%)

Urban Planning & Regional Development

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce principles of urban and regional planning
2. Understand city growth and development patterns
3. Study planning frameworks and policies
4. Relate planning concepts to architectural practice
5. Develop analytical understanding of urban systems

Course Outcomes
CO1 Understanding of urban planning principles
CO2 Analysis of city and regional development
CO3 Awareness of planning policies and frameworks
CO4 Integration of planning with architectural design
CO5 Urban analytical capability

Detailed Syllabus

Unit I
Urban planning concepts; scope and objectives; urbanization trends; city systems; relationship between planning and architecture; planning scales and hierarchy.

Unit II
Urban growth theories; concentric zone, sector, multiple nuclei models; urban sprawl; metropolitan development patterns; implications on built form.

Unit III
Land use planning; zoning regulations; density controls; FAR, setbacks; mixed-use development; impact on urban form and architecture.

Unit IV
Regional planning; regional resources; transportation networks; economic linkages; balanced regional development strategies.

Unit V
Urban planning in India; planning institutions; master plans; development plans; contemporary urban challenges and policy responses.

Text Books

1. Rangwala, S. C. (2019). *Town planning*. Charotar Publishing House.
2. Gallion, A. (2016). *The urban pattern*. Van Nostrand Reinhold.
3. Keeble, L. (2017). *Principles and practice of town and country planning*. Routledge.
4. Hall, P. (2018). *Cities of tomorrow*. Wiley.
5. Chapin, F. (2015). *Urban land use planning*. University of Illinois Press.

Reference Books

1. Jacobs, J. (2014). *The death and life of great American cities*. Vintage.
2. Lynch, K. (2015). *The image of the city*. MIT Press.
3. UN-Habitat. (2019). *Urban planning guidelines*. United Nations.
4. Kostof, S. (2016). *The city shaped*. Thames & Hudson.
5. Government of India. (2020). *Urban development policies*. GOI.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Transportation Planning & Infrastructure

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand transportation systems and infrastructure
2. Study movement patterns and mobility planning
3. Integrate transport with land use planning
4. Relate infrastructure to urban design
5. Promote sustainable transportation solutions

Course Outcomes
CO1 Understanding of transportation systems
CO2 Analysis of movement and mobility patterns
CO3 Integration of transport and land use

CO4 Awareness of infrastructure planning
CO5 Sustainable mobility planning capability

Detailed Syllabus

Unit I
Transportation planning overview; role of transport in urban development; modes of transport; mobility patterns; relationship with land use.

Unit II
Road networks; hierarchy of roads; design principles; right of way; intersections; pedestrian and non-motorized transport considerations.

Unit III
Public transportation systems; buses, rail, metro; transit-oriented development concepts; station area planning.

Unit IV
Traffic engineering basics; traffic surveys; capacity, level of service; parking planning; traffic management strategies.

Unit V
Sustainable transportation; integrated mobility; smart transport systems; environmental impacts; policy and planning considerations.

Text Books

1. Khanna, S. K., & Justo, C. (2018). *Highway engineering*. Nem Chand.
2. Papacostas, C. (2017). *Transportation engineering and planning*. Pearson.
3. Ortuzar, J. (2016). *Modelling transport*. Wiley.
4. Rodrigue, J. (2018). *The geography of transport systems*. Routledge.
5. Vuchic, V. (2017). *Urban transit systems*. Wiley.

Reference Books

1. IRC. (2019). *Transportation guidelines*. IRC.
2. Cervero, R. (2014). *The transit metropolis*. Island Press.
3. Newman, P. (2015). *Sustainable transport*. Island Press.
4. UN-Habitat. (2019). *Urban mobility*. United Nations.
5. Government of India. (2020). *National transport policy*. GOI.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Building Codes, Regulations & By-Laws

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand statutory building regulations
2. Study national and local building codes
3. Interpret development control rules
4. Integrate regulatory compliance in design
5. Prepare for professional practice responsibilities

Course Outcomes
CO1 Knowledge of building regulations and codes
CO2 Interpretation of development control rules
CO3 Application of codes in design proposals
CO4 Regulatory compliance capability
CO5 Professional accountability awareness

Detailed Syllabus

Unit I
Building regulations overview; purpose, scope; statutory approvals; roles of authorities; regulatory framework in India.

Unit II
National Building Code of India; structure; provisions related to safety, fire, services; relevance to architectural design.

Unit III
Development control regulations; zoning, FAR, setbacks, height controls; plot coverage; application in design.

Unit IV
Fire and life safety regulations; means of egress; fire separation; occupancy classification; integration with design.

Unit V
Accessibility and environmental regulations; barrier-free design; environmental clearance; compliance documentation.

Text Books

1. NBC. (2016). *National building code of India*. BIS.
2. Rangwala, S. C. (2019). *Town planning*. Charotar Publishing House.

3. Arora, S. P. (2018). *Building bylaws*. Dhanpat Rai Publishing.
4. COA. (2017). *Architects act and regulations*. COA.
5. Wakchaure, M. (2016). *Professional practice*. McGraw-Hill.

Reference Books

1. BIS. (2018). *Indian standards for buildings*. BIS.
2. Government of India. (2020). *Urban development acts*. GOI.
3. CPWD. (2019). *Building regulations handbook*. CPWD.
4. Emmitt, S. (2018). *Architectural management*. Wiley.
5. Hudson, J. (2016). *Architectural practice handbook*. RIBA.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Practice – II

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Advance professional practice knowledge
2. Understand project execution and management
3. Study legal and contractual responsibilities
4. Enhance client and consultant coordination skills
5. Prepare for independent professional roles

Course Outcomes
CO1 Advanced professional practice understanding
CO2 Project execution knowledge
CO3 Legal and contractual awareness
CO4 Coordination and management skills
CO5 Professional readiness

Detailed Syllabus

Unit I
Project management basics; stages of project execution; roles of stakeholders; coordination mechanisms.

Unit II
Contracts administration; tender evaluation; award of work; contractual obligations; dispute resolution basics.

Unit III
Construction supervision; quality control; site meetings; documentation; role of architect during execution.

Unit IV
Legal aspects; professional liability; arbitration; insurance; risk management in architectural practice.

Unit V
Contemporary practice issues; sustainability mandates; technology integration; emerging professional models.

Text Books

1. Rangwala, S. C. (2019). *Professional practice*. Charotar Publishing House.
2. Roshan, R. (2018). *Professional practice*. CBS Publishers.
3. Hudson, J. (2016). *Architectural practice handbook*. RIBA.
4. Emmitt, S. (2018). *Architectural management*. Wiley.
5. COA. (2020). *Professional guidelines*. COA.

Reference Books

1. Ashworth, A. (2017). *Contractual procedures*. Pearson.
2. Davis, M. (2015). *Ethics in architecture*. Routledge.
3. Potts, K. (2016). *Construction cost management*. Routledge.
4. Harris, F. (2017). *Modern construction management*. Wiley.
5. RICS. (2019). *Project management guidance*. RICS.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Elective III (Disaster-Resilient Architecture)

Course Category: Professional Elective Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand disaster risks and impacts on built environment

2. Introduce principles of disaster-resilient design
3. Study mitigation and preparedness strategies
4. Integrate resilience into architectural planning
5. Promote safe and adaptive design practices

Course Outcomes
CO1 Knowledge of disaster risks
CO2 Understanding of resilience principles
CO3 Application of mitigation strategies
CO4 Integration of resilience in design
CO5 Preparedness for disaster-responsive practice

Detailed Syllabus

Unit I
Disasters overview; natural and man-made disasters; vulnerability; risk assessment; impact on settlements and buildings.

Unit II
Seismic design concepts; earthquake-resistant principles; building configuration; materials and detailing strategies.

Unit III
Flood and cyclone resilience; site planning; structural measures; materials; building envelope considerations.

Unit IV
Fire and industrial hazards; risk mitigation; planning and design strategies; safety integration.

Unit V
Post-disaster reconstruction; rehabilitation; policy frameworks; role of architects in disaster management.

Text Books

1. Arya, A. (2018). *Earthquake resistant design*. Oxford University Press.
2. Coburn, A. (2016). *Disaster risk reduction*. UNDP.
3. UNISDR. (2019). *Disaster resilience*. United Nations.
4. Murty, C. (2017). *Learning earthquake design*. IIT Kanpur.
5. Davis, I. (2015). *Shelter after disaster*. Oxford.

Reference Books

1. IS Codes. (2018). *Seismic design standards*. BIS.
2. World Bank. (2019). *Disaster risk management*. World Bank.

3. UN-Habitat. (2018). *Resilient cities*. United Nations.
4. FEMA. (2017). *Disaster mitigation*. FEMA.
5. NDMA. (2020). *Disaster management guidelines*. NDMA.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Consolidate urban-scale professional exposure
2. Understand planning and regulatory practice
3. Enhance interdisciplinary coordination skills
4. Relate advanced academic learning to practice
5. Develop professional maturity

Course Outcomes
CO1 Advanced professional exposure
CO2 Planning and regulatory understanding
CO3 Interdisciplinary coordination capability
CO4 Application of academic learning
CO5 Professional maturity

Guidelines
Advanced internship with architectural, planning, or infrastructure organizations; supervised responsibilities; documentation; report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER VIII

Architectural Design Studio – VIII

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Address advanced architectural problems with technological integration
2. Incorporate smart systems and contemporary building technologies
3. Integrate structural, services, and management considerations
4. Develop comprehensive design resolution and detailing
5. Strengthen professional design leadership and presentation

Course Outcomes
CO1 Advanced architectural design competency
CO2 Integration of smart technologies in design
CO3 Comprehensive technical coordination capability
CO4 High-level detailing and resolution proficiency
CO5 Professional presentation and leadership skills

List of Exercises / Studio Tasks

1. Analysis of complex site conditions including urban infrastructure, environmental constraints, and regulatory frameworks using analytical diagrams.
2. Design of advanced institutional, commercial, or mixed-use buildings incorporating smart building concepts.
3. Integration of intelligent systems including automation, energy management, and building controls within design proposals.
4. Coordination of structural systems, services, and circulation in technologically complex buildings.
5. Preparation of detailed architectural drawings including plans, sections, elevations, and technical details.
6. Development of massing and façade strategies responding to technology, climate, and urban context.
7. Preparation of sustainability and performance diagrams supporting design decisions.
8. Iterative refinement through technical reviews and interdisciplinary critiques.

9. Preparation of comprehensive presentation drawings, physical models, and digital simulations.
10. Final jury presentation emphasizing technological integration, architectural quality, and professional rigor.

Expected Outcomes
Advanced design resolution, smart systems integration, professional-level competence

Evaluation Scheme
Continuous Studio Assessment (100%)

Smart Buildings & Intelligent Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand concepts of smart buildings
2. Introduce intelligent building systems and automation
3. Integrate technology with architectural design
4. Promote energy efficiency and user comfort
5. Support future-ready architectural practice

Course Outcomes
CO1 Understanding of smart building concepts
CO2 Knowledge of intelligent systems and automation
CO3 Integration of technology in architectural design
CO4 Energy-efficient and responsive design capability
CO5 Preparedness for technology-driven practice

Detailed Syllabus

Unit I
Smart building concepts; evolution of intelligent buildings; building automation systems; sensors, actuators; integration of technology with architectural planning and design frameworks.

Unit II
Building management systems; monitoring, control, data acquisition; HVAC, lighting, security integration; operational efficiency and performance optimization.

Unit III
Energy management systems; smart grids; renewable integration; demand response; energy monitoring; sustainability and efficiency considerations in buildings.

Unit IV
Intelligent lighting and security systems; access control; surveillance; fire detection; safety integration; user comfort and building performance enhancement.

Unit V
Internet of Things in buildings; data-driven design; predictive maintenance; user interfaces; challenges, limitations, and future trends in smart architecture.

Text Books

1. Sinopoli, J. (2018). *Smart building systems*. Butterworth-Heinemann.
2. Wang, S. (2016). *Intelligent buildings and building automation*. Taylor & Francis.
3. Lechner, N. (2015). *Heating, cooling, lighting*. Wiley.
4. Edwards, B. (2014). *Rough guide to sustainability*. RIBA.
5. Kibert, C. (2016). *Sustainable construction*. Wiley.

Reference Books

1. ASHRAE. (2019). *Handbook of HVAC applications*. ASHRAE.
2. CIBSE. (2018). *Building automation guide*. CIBSE.
3. IBM. (2017). *Smart buildings*. IBM Press.
4. Ratti, C. (2017). *Smart cities*. MIT Press.
5. World Economic Forum. (2019). *Shaping the future of buildings*. WEF.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Advanced Structural Systems

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Study advanced structural systems and forms
2. Understand long-span and high-rise structures
3. Integrate structural systems with architectural intent
4. Develop conceptual structural design skills
5. Support innovative architectural solutions

Course Outcomes
CO1 Knowledge of advanced structural systems
CO2 Understanding of structural form and efficiency
CO3 Integration of structure and architecture
CO4 Conceptual structural design capability
CO5 Preparedness for complex structural applications

Detailed Syllabus

Unit I
Advanced structural forms; shells, domes, space frames; load transfer mechanisms; efficiency of structural forms in architectural applications.

Unit II
Long-span structures; trusses, arches, cable structures; stadiums, auditoria; design considerations and architectural integration.

Unit III
High-rise structural systems; shear walls, cores, outrigger systems; wind and seismic considerations; structural planning.

Unit IV
Composite and hybrid systems; steel concrete composites; advantages; applications; coordination with architectural design.

Unit V
Structural innovation; new materials; digital tools; performance-based design concepts; future trends in structural architecture.

Text Books

1. Engel, H. (2018). *Structure systems*. Hatje Cantz.
2. Schodek, D. (2014). *Structures*. Pearson.
3. Salvadori, M. (2017). *Why buildings stand up*. Norton.
4. Allen, E. (2016). *How buildings work*. Oxford University Press.
5. Ambrose, J. (2015). *Simplified engineering for architects*. Wiley.

Reference Books

1. Ching, F. D. K. (2015). *Building structures illustrated*. Wiley.
2. Megson, T. (2019). *Structural and stress analysis*. Butterworth-Heinemann.
3. Macdonald, A. (2016). *Structure and architecture*. Routledge.
4. Addis, B. (2017). *Building with new materials*. Routledge.
5. Otto, F. (2014). *Finding form*. Edition Axel Menges.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Project Management & Construction Planning

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand construction project management principles
2. Study planning, scheduling, and control techniques
3. Integrate management with architectural execution
4. Develop coordination and decision-making skills
5. Prepare for leadership roles in project delivery

Course Outcomes
CO1 Knowledge of project management fundamentals
CO2 Construction planning and scheduling ability
CO3 Coordination and control skills
CO4 Application of management tools
CO5 Professional leadership preparedness

Detailed Syllabus

Unit I
Project management concepts; project life cycle; stakeholders; objectives; relevance to construction and architectural projects.

Unit II
Construction planning; work breakdown structures; sequencing; methods of construction; coordination aspects.

Unit III
Scheduling techniques; bar charts; CPM; PERT; time management; monitoring and control methods.

Unit IV
Cost and quality management; budgeting; cost control; quality assurance; risk management basics.

Unit V
Project coordination; communication; contract administration; safety management; contemporary project management practices.

Text Books

1. K.K. Chitkara. (2017). *Construction project management*. Tata McGraw-Hill.
2. Kharbanda, O. (2018). *Project management*. McGraw-Hill.
3. Harris, F. (2017). *Modern construction management*. Wiley.
4. Kerzner, H. (2019). *Project management*. Wiley.
5. Rangwala, S. C. (2019). *Professional practice*. Charotar Publishing House.

Reference Books

1. PMI. (2017). *PMBOK guide*. PMI.
2. Potts, K. (2016). *Construction cost management*. Routledge.
3. Emmitt, S. (2018). *Architectural management*. Wiley.
4. Ashworth, A. (2017). *Contractual procedures*. Pearson.
5. Walker, A. (2015). *Project management in construction*. Wiley.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Research Methods in Architecture

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Introduce research methodologies in architecture
2. Develop analytical and critical inquiry skills
3. Understand qualitative and quantitative methods
4. Prepare for research projects and thesis
5. Strengthen academic writing and ethics

Course Outcomes
CO1 Understanding of architectural research methods
CO2 Research design and analysis capability
CO3 Critical evaluation skills
CO4 Academic writing proficiency
CO5 Research preparedness

Detailed Syllabus

Unit I
Research in architecture; nature, scope; types of research; design research; relevance to architectural practice and academia.

Unit II
Research process; problem identification; objectives; hypotheses; literature review techniques.

Unit III
Research methods; qualitative, quantitative, mixed methods; surveys; case studies; observation techniques.

Unit IV
Data analysis; basic statistics; interpretation; graphical representation; validity and reliability considerations.

Unit V
Research ethics; referencing; plagiarism; report writing; preparation of research proposals.

Text Books

1. Groat, L., & Wang, D. (2018). *Architectural research methods*. Wiley.
2. Creswell, J. (2017). *Research design*. Sage.
3. Kumar, R. (2016). *Research methodology*. Sage.
4. Yin, R. (2018). *Case study research*. Sage.
5. Booth, W. (2016). *The craft of research*. University of Chicago Press.

Reference Books

1. Flick, U. (2015). *Introducing research methodology*. Sage.
2. Silverman, D. (2017). *Doing qualitative research*. Sage.
3. Bryman, A. (2016). *Social research methods*. Oxford.
4. Turabian, K. (2018). *A manual for writers*. University of Chicago Press.
5. COPE. (2019). *Publication ethics*. COPE.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Elective IV (Heritage Conservation)

Course Category: Professional Elective Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Understand heritage conservation principles
2. Study historic building materials and techniques
3. Develop conservation planning skills
4. Integrate heritage concerns in contemporary practice
5. Promote cultural sustainability

Course Outcomes
CO1 Knowledge of heritage conservation concepts
CO2 Understanding of historic materials and techniques
CO3 Conservation planning and analysis skills
CO4 Integration of heritage with development
CO5 Cultural sustainability awareness

Detailed Syllabus

Unit I
Introduction to heritage; definitions; types; values; significance assessment; relevance to architecture and planning.

Unit II
Historic building materials; traditional construction techniques; decay mechanisms; material conservation approaches.

Unit III
Conservation principles; restoration, preservation, adaptive reuse; charters and guidelines; ethical considerations.

Unit IV
Documentation and condition assessment; measured drawings; recording techniques; diagnostic studies.

Unit V
Conservation management; policies; community participation; case studies; integration with contemporary development.

Text Books

1. Jokilehto, J. (2017). *A history of architectural conservation*. Routledge.
2. Feilden, B. (2016). *Conservation of historic buildings*. Routledge.

3. Orbasli, A. (2018). *Architectural conservation*. Wiley.
4. Stubbs, J. (2016). *Time honored*. Wiley.
5. ICCROM. (2019). *Conservation guidelines*. ICCROM.

Reference Books

1. ICOMOS. (2017). *Venice charter*. ICOMOS.
2. Jokilehto, J. (2016). *Management guidelines*. ICCROM.
3. Ashurst, J. (2015). *Practical building conservation*. English Heritage.
4. Petzet, M. (2014). *Principles of preservation*. Getty.
5. Government of India. (2020). *Heritage policies*. GOI.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Consolidate advanced professional exposure
2. Understand complex project environments
3. Enhance interdisciplinary coordination skills
4. Relate advanced academic learning to practice
5. Develop professional readiness for PG-level studies

Course Outcomes
CO1 Advanced professional exposure
CO2 Complex project understanding
CO3 Interdisciplinary coordination capability
CO4 Application of academic learning
CO5 Professional readiness

Guidelines
Advanced internship with architectural, engineering, or planning organizations; supervised responsibilities; documentation; report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER IX

Advanced Architectural Design Studio – I

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Address postgraduate-level architectural design problems
2. Integrate advanced theory, technology, and research inputs
3. Respond to complex urban, environmental, and social contexts
4. Develop rigorous design methodologies and critical inquiry
5. Strengthen leadership in architectural design and presentation

Course Outcomes
CO1 Postgraduate-level architectural design capability
CO2 Integration of research and theory into design
CO3 Contextual, technological, and environmental responsiveness
CO4 Advanced design resolution and detailing proficiency
CO5 Professional leadership and critical presentation skills

List of Exercises / Studio Tasks

1. Identification and formulation of complex architectural problems through research-led site and context analysis.
2. Development of design concepts grounded in theory, precedent studies, and analytical frameworks.
3. Integration of advanced structural, services, sustainability, and technological systems in design proposals.
4. Preparation of comprehensive architectural drawings at urban, building, and detail scales.
5. Exploration of innovative spatial typologies, materials, and construction systems.
6. Development of performance-based design strategies addressing energy, comfort, and sustainability.
7. Iterative design development through critical reviews, seminars, and expert critiques.
8. Preparation of detailed design documentation including drawings, models, and simulations.

9. Articulation of design intent through written statements, diagrams, and visual narratives.
10. Final jury presentation emphasizing research integration, innovation, and architectural rigor.

Expected Outcomes
Research-integrated design maturity, postgraduate architectural competence, professional leadership

Evaluation Scheme
Continuous Studio Assessment (100%)

Advanced Urban Design & City Planning

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced understanding of urban design and planning
2. Analyze complex urban systems and city structures
3. Integrate policy, infrastructure, and design strategies
4. Address metropolitan and regional planning challenges
5. Support research-oriented urban design practice

Course Outcomes
CO1 Advanced urban design and planning knowledge
CO2 Critical analysis of urban systems
CO3 Integration of policy and design strategies
CO4 City-scale planning and design capability
CO5 Research-oriented urban design competence

Detailed Syllabus

Unit I
Advanced urban design concepts; metropolitan regions; city form and structure; governance frameworks; relationship between planning, policy, and urban design practice.

Unit II
Urban analysis methods; spatial analytics; socio-economic indicators; land use modeling; interpretation of complex urban data for planning decisions.

Unit III
Urban infrastructure systems; transportation, utilities, housing; integration strategies; resilience and sustainability in city planning contexts.

Unit IV
Urban regeneration and redevelopment; brownfield sites; inner-city renewal; policy instruments; stakeholder engagement processes.

Unit V
Smart cities and future urbanism; digital technologies; data-driven planning; climate adaptation; emerging trends in city planning and design.

Text Books

1. Carmona, M. (2018). *Public places urban spaces*. Routledge.
2. Hall, P. (2018). *Cities of tomorrow*. Wiley.
3. Batty, M. (2017). *The new science of cities*. MIT Press.
4. Lynch, K. (2015). *The image of the city*. MIT Press.
5. UN-Habitat. (2019). *Planning sustainable cities*. United Nations.

Reference Books

1. Jacobs, J. (2014). *The death and life of great American cities*. Vintage.
2. Gehl, J. (2017). *Life between buildings*. Island Press.
3. Healey, P. (2016). *Urban complexity*. Palgrave.
4. Florida, R. (2019). *The new urban crisis*. Basic Books.
5. Government of India. (2020). *Smart cities mission guidelines*. GOI.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Computational Design & Parametric Modelling

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Introduce computational thinking in architectural design
2. Develop parametric and algorithmic design skills
3. Integrate digital tools with design exploration
4. Support performance-driven and generative design
5. Prepare for advanced digital architectural practice

Course Outcomes
CO1 Computational design understanding
CO2 Parametric modeling proficiency
CO3 Algorithmic design application
CO4 Performance-based design capability
CO5 Digital innovation readiness

List of Experiments / Exercises

1. Introduction to computational design concepts, visual programming environments, and parametric workflows for architecture.
2. Creation of parametric geometries using algorithmic relationships and variable-driven form generation.
3. Development of rule-based design systems controlling form, structure, and spatial organization.
4. Exploration of generative design techniques using iterative algorithms and pattern logic.
5. Integration of environmental parameters such as daylight, solar angles, and airflow into parametric models.
6. Form-finding exercises using structural and material constraints within computational frameworks.
7. Optimization of architectural forms using performance criteria and parametric variations.
8. Translation of parametric models into architectural drawings and fabrication-ready outputs.
9. Documentation of computational design processes through diagrams, scripts, and models.
10. Final project demonstrating parametric design application to an architectural problem.

Expected Outcomes
Parametric modeling competence, computational design literacy, performance-driven design capability

Evaluation Scheme
Continuous Assessment (100%)

Building Information Modelling (BIM)

Course Category: Core Engineering Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Understand principles and workflows of BIM
2. Develop coordinated digital building models
3. Integrate multidisciplinary information in BIM
4. Support construction documentation and management
5. Prepare for collaborative professional practice

Course Outcomes
CO1 BIM concepts and workflow understanding
CO2 Coordinated building model development
CO3 Multidisciplinary data integration capability
CO4 BIM-based documentation proficiency
CO5 Collaborative practice readiness

List of Experiments / Exercises

1. Introduction to BIM environment, model setup, levels, grids, and project organization.
2. Creation of architectural BIM models including walls, floors, roofs, doors, and windows.
3. Integration of structural and services elements into coordinated BIM models.
4. Development of parametric families for building components and assemblies.
5. Generation of drawings, schedules, and quantities directly from BIM models.
6. Clash detection and coordination between architectural, structural, and services models.
7. Application of BIM for construction sequencing and basic 4D visualization.
8. Use of BIM for quantity take-off and cost-related information extraction.
9. Model checking, documentation standards, and data management practices.
10. Final BIM project demonstrating integrated building modeling and documentation.

Expected Outcomes
BIM proficiency, coordinated digital documentation skills, collaborative workflow understanding

Evaluation Scheme
Continuous Assessment (100%)

Elective V (Sustainable Urban Systems)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Study sustainability at urban and regional scales
2. Understand systems-based urban sustainability
3. Integrate infrastructure, ecology, and planning
4. Support resilient and low-carbon urban design
5. Advance elective-based specialization

Course Outcomes
CO1 Knowledge of sustainable urban systems
CO2 Systems-based sustainability understanding
CO3 Integration of ecology and infrastructure
CO4 Resilient urban design capability
CO5 Advanced sustainability specialization

Detailed Syllabus

Unit I
Urban sustainability concepts; systems thinking; metabolism of cities; resource flows; sustainability indicators and metrics.

Unit II
Urban energy systems; renewable integration; district energy; low-carbon strategies; energy planning at city scale.

Unit III
Water-sensitive urban design; stormwater management; urban hydrology; blue-green infrastructure systems.

Unit IV
Urban ecology; green networks; biodiversity planning; ecosystem services; climate adaptation strategies.

Unit V
Policy and governance; sustainability frameworks; international best practices; implementation challenges in developing contexts.

Text Books

1. Newman, P. (2015). *Resilient cities*. Island Press.
2. Beatley, T. (2016). *Green urbanism*. Island Press.

3. Register, R. (2017). *Ecocities*. New Society Publishers.
4. UN-Habitat. (2019). *Urban sustainability*. United Nations.
5. Girardet, H. (2015). *Creating sustainable cities*. Routledge.

Reference Books

1. Hodson, M. (2017). *Sustainable cities*. Routledge.
2. Campbell, S. (2016). *Planning sustainable cities*. MIT Press.
3. Bulkeley, H. (2015). *Cities and climate change*. Routledge.
4. World Bank. (2019). *Sustainable urban development*. World Bank.
5. Government of India. (2020). *Urban sustainability policies*. GOI.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Seminar

Course Category: Humanities & Management Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Develop academic research and presentation skills
2. Engage with advanced architectural topics
3. Strengthen critical reading and synthesis abilities
4. Prepare for thesis-level research work
5. Enhance scholarly communication competence

Course Outcomes
CO1 Advanced topic identification capability
CO2 Critical literature review skills
CO3 Academic presentation proficiency
CO4 Research articulation competence
CO5 Readiness for thesis preparation

Guidelines
Selection of contemporary or research-oriented architectural topic; literature survey; seminar paper preparation; oral presentation; peer and faculty evaluation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER X

Advanced Architectural Design Studio – II

Course Category: Core Engineering Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Address thesis-oriented architectural design problems
2. Integrate advanced research, technology, and theory
3. Respond to complex socio-cultural and environmental contexts
4. Develop independent design positions and methodologies
5. Demonstrate professional-level design leadership

Course Outcomes
CO1 Thesis-oriented architectural design capability
CO2 Research-integrated design development
CO3 Advanced contextual and technological responsiveness
CO4 High-level architectural resolution and detailing
CO5 Professional design leadership and communication

List of Exercises / Studio Tasks

1. Identification and formulation of a complex architectural problem aligned with individual research interests.
2. In-depth site, context, and precedent analysis supporting design problem definition.
3. Development of a strong conceptual framework integrating research findings and design intent.
4. Integration of advanced structural, environmental, and service systems within architectural proposals.
5. Preparation of comprehensive architectural drawings at urban, building, and detail scales.
6. Exploration of innovative materials, construction techniques, and spatial typologies.
7. Performance-based design evaluation addressing sustainability, energy, and user comfort.
8. Iterative design refinement through critical reviews, expert panels, and studio critiques.

9. Preparation of complete design documentation including drawings, models, and simulations.
10. Final jury presentation demonstrating research rigor, innovation, and architectural excellence.

Expected Outcomes
Independent design maturity, research-driven architectural competence, thesis preparedness

Evaluation Scheme
Continuous Studio Assessment (100%)

Energy Efficient Buildings & Climate Responsive Design

Course Category: Core Engineering Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced understanding of energy-efficient building design
2. Apply climate-responsive architectural strategies
3. Integrate passive and active energy systems
4. Evaluate building energy performance
5. Support low-energy and sustainable architectural solutions

Course Outcomes
CO1 Knowledge of energy-efficient building principles
CO2 Application of climate-responsive design strategies
CO3 Integration of passive and active systems
CO4 Building energy performance evaluation capability
CO5 Sustainable architectural decision-making

Detailed Syllabus

Unit I
Energy use in buildings; energy demand patterns; building energy balance; climatic influences; role of architecture in energy conservation and efficiency enhancement.

Unit II
Climate-responsive design strategies; orientation; building form; envelope design; passive heating and cooling techniques; regional climatic responses.

Unit III
Passive design systems; thermal mass; natural ventilation; shading devices; daylight integration; comfort optimization approaches.

Unit IV
Active energy systems; HVAC efficiency; lighting systems; renewable energy integration; solar, wind applications; building energy management concepts.

Unit V
Energy simulation and evaluation; performance metrics; energy codes; building energy rating systems; compliance and design optimization processes.

Text Books

1. Lechner, N. (2015). *Heating, cooling, lighting*. Wiley.
2. Szokolay, S. (2014). *Introduction to architectural science*. Routledge.
3. Givoni, B. (2016). *Climate considerations in building*. Wiley.
4. Kibert, C. (2016). *Sustainable construction*. Wiley.
5. ASHRAE. (2019). *Handbook of fundamentals*. ASHRAE.

Reference Books

1. Olgyay, V. (2015). *Design with climate*. Princeton University Press.
2. Hyde, R. (2018). *Climate responsive design*. Taylor & Francis.
3. TERI. (2020). *Energy efficient buildings*. TERI Press.
4. NBC. (2016). *Energy conservation building code*. BIS.
5. Edwards, B. (2014). *Rough guide to sustainability*. RIBA.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Research Seminar & Publication Ethics

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Develop advanced research communication skills
2. Understand academic publishing processes
3. Promote ethical research and publication practices
4. Prepare for thesis research dissemination
5. Strengthen scholarly writing competence

Course Outcomes
CO1 Research presentation and articulation capability
CO2 Understanding of publication processes
CO3 Awareness of research and publication ethics
CO4 Academic writing proficiency
CO5 Thesis research preparedness

Detailed Syllabus

Unit I
Research dissemination; conferences, journals; peer review process; impact factors; indexing systems; relevance to architectural research.

Unit II
Academic writing standards; structuring research papers; abstracts, keywords; citations; referencing styles; clarity and coherence.

Unit III
Publication ethics; plagiarism; authorship; data integrity; copyright issues; ethical responsibilities of researchers.

Unit IV
Research metrics; citations; h-index; research visibility; open access publishing; academic profiles.

Unit V
Preparation of research manuscripts; submission procedures; reviewer responses; revision strategies; publication planning.

Text Books

1. Booth, W. (2016). *The craft of research*. University of Chicago Press.
2. Day, R. (2017). *How to write and publish a scientific paper*. Cambridge University Press.
3. Kumar, R. (2016). *Research methodology*. Sage.
4. Creswell, J. (2017). *Research design*. Sage.
5. COPE. (2019). *Publication ethics guidelines*. COPE.

Reference Books

1. Turabian, K. (2018). *A manual for writers*. University of Chicago Press.
2. Elsevier. (2019). *Publishing ethics*. Elsevier.
3. Springer. (2018). *Author guidelines*. Springer.
4. Wager, E. (2016). *Getting research published*. Radcliffe.

5. Council of Architecture. (2020). *Research guidelines*. COA.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Elective VI (Advanced Construction Technologies)

Course Category: Professional Elective Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Study emerging construction technologies
2. Understand advanced materials and systems
3. Integrate technology with architectural execution
4. Promote innovation in construction practices
5. Support advanced professional specialization

Course Outcomes
CO1 Knowledge of advanced construction technologies
CO2 Application of innovative materials and systems
CO3 Integration of technology in architectural projects
CO4 Constructability and execution awareness
CO5 Advanced professional competence

Detailed Syllabus

Unit I
Advanced construction technologies overview; digital fabrication; automation; prefabrication; relevance to contemporary architectural practice.

Unit II
High-performance materials; composites; smart materials; nanomaterials; applications in building systems and envelopes.

Unit III
Digital construction; BIM-based execution; robotics; 3D printing; off-site construction methodologies.

Unit IV
Sustainable construction technologies; low-carbon construction; waste minimization; circular economy concepts.

Unit V
Future trends; construction innovation; industry challenges; regulatory and professional implications.

Text Books

1. Addis, B. (2017). *Building with new materials*. Routledge.
2. Knaack, U. (2016). *Prefabricated systems*. Birkhäuser.
3. Eastman, C. (2018). *BIM handbook*. Wiley.
4. Allen, E., & Iano, J. (2019). *Fundamentals of building construction*. Wiley.
5. Harris, F. (2017). *Modern construction management*. Wiley.

Reference Books

1. Schodek, D. (2014). *Structures*. Pearson.
2. Otto, F. (2014). *Finding form*. Edition Axel Menges.
3. Peurifoy, R. (2016). *Construction planning*. McGraw-Hill.
4. IS Codes. (2018). *Advanced construction practices*. BIS.
5. World Economic Forum. (2019). *Future of construction*. WEF.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Minor Research Project

Course Category: Project Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Undertake independent research inquiry
2. Apply research methods to architectural problems
3. Develop analytical and critical thinking skills
4. Prepare foundation for thesis research
5. Strengthen research documentation capability

Course Outcomes
CO1 Independent research capability
CO2 Application of research methodology
CO3 Analytical and critical evaluation skills
CO4 Research documentation proficiency
CO5 Thesis readiness

Guidelines
Selection of research topic aligned with architectural specialization; formulation of objectives

and methodology; data collection and analysis; preparation of research report; presentation and evaluation.

Evaluation Scheme
Continuous Assessment (100%)

Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 1 Credit / 15 Contact Hours

Course Objectives

1. Gain advanced professional and research exposure
2. Understand complex architectural project environments
3. Integrate academic research with professional practice
4. Enhance professional competence and confidence
5. Prepare for thesis and independent practice

Course Outcomes
CO1 Advanced professional exposure
CO2 Research-practice integration ability
CO3 Professional competence development
CO4 Application of advanced academic knowledge
CO5 Readiness for thesis stage

Guidelines
Advanced internship with architectural, research, or professional organizations; defined scope; documentation; report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER XI

Thesis Preparation & Research Design

Course Category: Project Course
Credits / Contact Hours: 6 Credits / 90 Contact Hours

Course Objectives

1. Formulate a rigorous architectural research problem
2. Develop clear research objectives and questions
3. Establish appropriate research methodology and framework
4. Integrate literature, context, and analytical tools
5. Prepare a comprehensive thesis proposal and plan

Course Outcomes
CO1 Research problem formulation capability
CO2 Structured research design development
CO3 Critical literature synthesis proficiency
CO4 Methodological rigor and feasibility assessment
CO5 Readiness for thesis execution

Guidelines
Identification of thesis domain; problem statement formulation; objectives and scope definition; literature review synthesis; methodology selection; data sources and tools; work plan and timeline; ethics compliance; proposal documentation; review and approval process.

Evaluation Scheme
Continuous Assessment (100%)

Specialized Elective I (Urban Analytics / Smart Cities)

Course Category: Professional Elective Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Develop advanced knowledge in selected specialization domain
2. Apply analytical tools to urban and architectural systems
3. Integrate data-driven approaches with design and planning
4. Support research-led professional specialization
5. Enhance interdisciplinary competence

Course Outcomes
CO1 Advanced domain-specific knowledge
CO2 Application of analytical and digital tools
CO3 Data-driven decision-making capability
CO4 Integration of analytics with design and planning
CO5 Research-oriented specialization readiness

Detailed Syllabus

Unit I
Urban analytics and smart cities concepts; data-driven urbanism; spatial data types; GIS foundations; relevance to planning and architectural decision-making.

Unit II
Urban data acquisition; remote sensing; sensors; open data platforms; data quality, scale, and resolution considerations.

Unit III
Analytical tools and methods; spatial analysis; visualization techniques; modeling urban patterns and performance indicators.

Unit IV
Smart city systems; mobility, energy, water, governance; ICT integration; performance monitoring and optimization frameworks.

Unit V
Policy, ethics, and implementation; data governance; privacy concerns; case studies; challenges and future directions in smart urban systems.

Text Books

1. Batty, M. (2017). *The new science of cities*. MIT Press.
2. Townsend, A. (2015). *Smart cities*. Norton.
3. Longley, P. (2015). *Geographic information systems*. Wiley.
4. Kitchin, R. (2016). *The data revolution*. Sage.
5. UN-Habitat. (2019). *Smart cities and urban analytics*. United Nations.

Reference Books

1. Gehl, J. (2017). *Life between buildings*. Island Press.
2. Healey, P. (2016). *Urban complexity*. Palgrave.
3. Government of India. (2020). *Smart cities mission*. GOI.
4. Ratti, C. (2017). *Smart cities*. MIT Press.
5. World Bank. (2019). *Urban analytics*. World Bank.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Specialized Elective II (Advanced Structural Optimization)

Course Category: Professional Elective Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Understand advanced structural optimization concepts
2. Apply computational methods to structural design
3. Integrate optimization with architectural intent
4. Support performance-driven structural solutions
5. Enhance research-based structural specialization

Course Outcomes
CO1 Advanced structural optimization knowledge
CO2 Computational and analytical skill development
CO3 Integration of structure and architectural form
CO4 Performance-based design capability
CO5 Research-oriented structural competence

Detailed Syllabus

Unit I
Structural optimization fundamentals; objectives, constraints; form-finding concepts; relevance to architectural and engineering integration.

Unit II
Computational methods; parametric modeling; algorithms; optimization techniques; iterative design processes.

Unit III
Material and structural efficiency; topology optimization; lightweight structures; sustainability considerations.

Unit IV
Performance evaluation; structural analysis; multi-criteria optimization; integration with environmental and construction parameters.

Unit V
Applications and case studies; high-rise, long-span structures; digital workflows; future trends in structural optimization.

Text Books

1. Bendsoe, M. (2015). *Topology optimization*. Springer.
2. Schodek, D. (2014). *Structures*. Pearson.
3. Engel, H. (2018). *Structure systems*. Hatje Cantz.
4. Macdonald, A. (2016). *Structure and architecture*. Routledge.
5. Megson, T. (2019). *Structural and stress analysis*. Butterworth-Heinemann.

Reference Books

1. Otto, F. (2014). *Finding form*. Edition Axel Menges.
2. Addis, B. (2017). *Building with new materials*. Routledge.
3. Allen, E. (2016). *How buildings work*. Oxford University Press.
4. Hibbeler, R. (2018). *Engineering mechanics*. Pearson.
5. IS Codes. (2018). *Advanced structural standards*. BIS.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Professional Practice – III

Course Category: Humanities & Management Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Address advanced professional practice challenges
2. Understand strategic and managerial aspects of practice
3. Study regulatory, legal, and contractual complexities
4. Prepare for leadership and independent professional roles
5. Integrate ethics and governance in practice

Course Outcomes
CO1 Advanced professional practice understanding
CO2 Strategic and managerial competence
CO3 Legal and regulatory awareness
CO4 Leadership and decision-making capability
CO5 Independent practice readiness

Detailed Syllabus

Unit I
Strategic practice management; firm structures; business models; branding; professional positioning in competitive environments.

Unit II
Advanced contracts and procurement; EPC, design-build; PPP models; risk allocation; dispute resolution mechanisms.

Unit III
Financial management; practice finance; taxation; project cash flow; professional sustainability.

Unit IV
Legal and regulatory environment; liability; arbitration; intellectual property; professional accountability.

Unit V
Ethics, governance, and leadership; professional conduct; social responsibility; emerging challenges in global practice.

Text Books

1. Rangwala, S. C. (2019). *Professional practice*. Charotar Publishing House.
2. Roshan, R. (2018). *Professional practice*. CBS Publishers.
3. Emmitt, S. (2018). *Architectural management*. Wiley.
4. Hudson, J. (2016). *Architectural practice handbook*. RIBA.
5. COA. (2020). *Professional guidelines*. COA.

Reference Books

1. Ashworth, A. (2017). *Contractual procedures*. Pearson.
2. Harris, F. (2017). *Modern construction management*. Wiley.
3. Davis, M. (2015). *Ethics in architecture*. Routledge.
4. RICS. (2019). *Practice management*. RICS.
5. Government of India. (2020). *Professional regulations*. GOI.

Evaluation Scheme
Continuous Assessment (40%) + End-Semester Examination (60%)

Industry / Research Internship

Course Category: Internship / Industrial Training Course
Credits / Contact Hours: 3 Credits / 45 Contact Hours

Course Objectives

1. Engage in advanced industry or research environments
2. Apply research and design skills in professional contexts
3. Develop interdisciplinary collaboration experience
4. Strengthen professional and research competence
5. Prepare for thesis execution and practice

Course Outcomes
CO1 Advanced industry or research exposure
CO2 Application of research and design skills
CO3 Interdisciplinary collaboration capability
CO4 Professional competence development
CO5 Thesis and practice readiness

Guidelines
Full-time internship with architectural firms, research institutions, consultancy organizations, or industry partners; defined objectives and deliverables; supervision and periodic review; documentation; report and presentation.

Evaluation Scheme
Continuous Assessment (100%)

SEMESTER XII

Thesis (Architecture & Engineering Integration)

Course Category: Project Course
Credits / Contact Hours: 14 Credits / 210 Contact Hours

Course Objectives

1. Undertake an independent, original architectural research–design inquiry
2. Integrate architecture with engineering, technology, and sustainability
3. Demonstrate advanced analytical, design, and problem-solving capability
4. Produce a comprehensive and rigorous thesis document and design output
5. Exhibit professional competence equivalent to postgraduate standards

Course Outcomes
CO1 Independent thesis problem formulation and execution capability
CO2 Integration of research, design, and engineering systems
CO3 Advanced analytical and critical evaluation proficiency
CO4 Comprehensive architectural resolution and documentation
CO5 Professional-level presentation and defense competence

Guidelines
Selection of approved thesis topic; refinement of objectives and scope; advanced literature synthesis; contextual, technical, and design investigations; iterative design development; integration of structural, environmental, and technological systems; preparation of drawings, models, simulations, and written dissertation; periodic reviews; final submission and defense before examination panel.

Evaluation Scheme
Continuous Assessment (100%)

Seminar & Viva-Voce

Course Category: Humanities & Management Course
Credits / Contact Hours: 4 Credits / 60 Contact Hours

Course Objectives

1. Evaluate depth of thesis research and design understanding
2. Assess clarity of conceptual and methodological framework
3. Examine ability to articulate and defend academic work

4. Validate integration of theory, design, and practice
5. Ensure readiness for professional and academic progression

Course Outcomes
CO1 Clear articulation of thesis objectives and outcomes
CO2 Critical defense of research and design decisions
CO3 Demonstration of comprehensive subject mastery
CO4 Professional academic communication competence
CO5 Readiness for professional practice or doctoral research

Guidelines
Formal seminar presentation of thesis work; structured viva-voce examination; evaluation by internal and external examiners; assessment of conceptual clarity, technical rigor, design resolution, and research contribution.

Evaluation Scheme
Seminar Presentation (40%) + Viva-Voce Examination (60%)

Portfolio & Professional Evaluation

Course Category: Humanities & Management Course
Credits / Contact Hours: 2 Credits / 30 Contact Hours

Course Objectives

1. Compile a comprehensive academic and professional portfolio
2. Demonstrate cumulative learning across the integrated programme
3. Present design, technical, and research competencies coherently
4. Prepare for professional registration and employment
5. Reflect on individual academic and professional development

Course Outcomes
CO1 Comprehensive academic and design portfolio preparation
CO2 Professional presentation and documentation skills
CO3 Demonstration of integrated programme learning outcomes
CO4 Career and professional readiness
CO5 Reflective and self-evaluative capability

Guidelines
Compilation of design studio works, technical projects, internships, research outputs, and thesis summary; structured portfolio presentation; professional review by faculty and external experts; evaluation of competence, consistency, and professional readiness.

Evaluation Scheme
Continuous Assessment (100%)