SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., CAD/CAM

EFFECTIVE FROM ACADEMIC YEAR 2025- 26 ADMITTED BATCH

R25 COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Core – I	Advanced CAD	3	0	0	3
Professional Core – II	Additive Manufacturing	3	0	0	3
Professional Elective – I	1. Advanced Finite Element and Boundary Element Methods 2. Experimental Stress Analysis 3. Sustainable Manufacturing	3	0	0	3
Professional Elective – II	1. Automation in Manufacturing 2. Computer-Aided Process Planning 3. Industrial Robotics	3	0	0	3
	Research Methodology and IPR	2	0	0	2
Lab – I	Advanced Computer Aided Design Lab	0	0	4	2
Lab – II	Additive Manufacturing Lab	0	0	4	2
Audit – I	Audit Course - I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

I Year II Semester

Course Code	Course Title	L	T	P	Credits
Professional Core – III	Computer Integrated Manufacturing	3	0	0	3
Professional Core – IV	Manufacturing Systems: Simulation Modelling and Analysis	3	0	0	3
Professional Elective – III	1. Intelligent Manufacturing Systems 2. Smart Manufacturing 3. Optimization Techniques and Applications	3	0	0	3
Professional Elective – IV	1. Mechatronics 2. MEMS: Design and Manufacturing 3. Fuzzy Logic and Neural Networks	3	0	0	3
	Mini Project with Seminar	0	0	4	2
Lab – III	Simulation of Manufacturing Systems Lab	0	0	4	2
Lab – IV	Computer Aided Manufacturing Lab	0	0	4	2
Audit – II	Audit Course- II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

II Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Elective – V	1. Design for Manufacturing and Assembly 2. Composite Materials 3. Artificial Intelligence Manufacturing	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review - II	0	0	18	6
	Total	**6**	**0**	**18**	**12**

II YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review - III	0	0	18	6
Dissertation	Dissertation Viva-Voce	0	0	42	14
	Total	**0**	**0**	**60**	**20**

***For Dissertation Work Review - I, please refer to R25 Academic Regulations.**

Audit Course I:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education

Audit Course II:

1. Constitution of India
2. Pedagogy Studies
3. Stress Management by Yoga
4. Personality Development through Life Enlightenment Skills

Open Elective:

1. Business Analytics
2. Waste to Energy
3. Concurrent Engineering
4. Industrial Safety

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
ADVANCED CAD
(Professional Core- I)

L	T	P	C
3	0	0	3

Prerequisites: Engineering Graphics, Basics of Solid Mechanics

Course Objectives:

1. To provide knowledge on geometric modeling and parametric design concepts.
2. To introduce curve, surface, and solid modeling techniques using CAD tools.
3. To understand finite element modeling and its CAD integration.
4. To apply CAD for design automation and optimization.
5. To develop skills in advanced CAD software and design validation tools.

Course Outcomes: At the end of this course, students will be able to

1. Understand the CAD process and geometric modelling concepts
2. Analyze the utility and application of wireframe modelling
3. Understand the concepts of surface modelling
4. Understand and apply the concepts of solid modelling techniques.
5. Understand graphics by using transformations and analyse the utility of data exchange formats with dimensioning and tolerances.

UNIT- I: CAD Tools and 3D Modeling

CAD Tools: Definition of CAD Tools, Graphics Standards, Graphics Software, Requirements of Graphics Software, Functional Areas of CAD, and Efficient Use of CAD Software.
Basics of Geometric Modelling: Requirement of Geometric 3D Modeling, Geometric Models, Geometric Construction Methods, Modelling Facilities Desired.

UNIT- II: Geometric Modeling Techniques

Classification of Wireframe Entities, Curve Representation Methods. Parametric Representation of Analytic Curves: Line, Circle, Arc, Conics. Parametric Representation of Synthetic Curves: Hermite Cubic Curve, Bezier Curve, B-Spline Curve wire, NURBS, Curve Manipulations.

UNIT- III: Surface Modeling Methods

Classification of Surface Entities, Surface Representation Methods. Parametric Representation of Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Parametric Representation of Synthetic Curves: Hermite Cubic Surface, Bezier Surface, B-Spline Surface, Blending Surface, Surface Manipulations.

UNIT- IV: Solid Modeling Concepts

Geometry and Topology, Boundary Representation, Euler Poincaré Formula, Euler Operators, Constructive Solid Geometry, CSG Primitives, Boolean Operators, CSG Expressions, Interior and Exterior, Closure, Sweeping, Linear and Non-Linear, Solid Manipulations, Feature Modeling.

UNIT- V: CAD Transformations and Standards

Transformations: 2-D And 3-D Transformations, Translation, Scaling, Rotation, Reflection, Concatenation, Homogeneous Coordinates, Perspective Projection, Orthographic Projection, Isometric Projection, Hidden Surface Removal, Shading, Rendering.

Evaluation Criteria: Evaluation Criteria of Cad Software, Data Exchange Formats, GKS, IGES, PHIGS, CGM, Step.

Dimensioning and Tolerances: Linear, Angular, Angular Dimensions, Maximum Material Condition (MMC), Least Material Condition (LMC), Regardless of Feature Size (RFS).

TEXT BOOKS:

1. CAD/CAM Concepts and Applications, Chennakesava R. Alavala, Prentice-Hall of India (PHI), 1st Edition, 2007.
2. Mastering CAD/CAM, Ibrahim Zeid, McGraw-Hill International Edition, 1st Edition, 2004.

REFERENCES BOOKS:

1. CAD/CAM: Computer-Aided Design and Manufacturing, Mikell P. Groover, Pearson Education, 1st Edition, 2003.
2. CAD / CAM / CIM P. Radhakrishnan and S. Subramanian, New Age International Publishers, 3rd Edition, 2008.
3. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson Education, 1st Edition, 2004.
4. Computer Numerical Control Concepts and Programming, Warren S. Seames, Thomson Delmar Learning, 1st Edition, 2002.
5. CAD/CAM Principles and Applications, P.N. Rao, TMH, 3rd Edition, 2010.
6. Mastering CAD/CAM, Ibrahim Zeid, McGraw-Hill Education, 1st Edition, 2007.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, I Semester

ADDITIVE MANUFACTURING

(Professional Core- II)

L	T	P	C
3	0	0	3

Prerequisites: Basics of Manufacturing, Basic knowledge in Calculus, Physics, Thermodynamics, and Chemistry

Course Objectives:

1. To introduce the fundamentals of additive manufacturing technologies and processes.
2. To explain the principles of various AM techniques like SLS, SLA, FDM, and 3DP.
3. To study materials used in additive manufacturing and their properties.
4. To explore applications of additive manufacturing in prototyping and production.
5. To provide insights into design guidelines, limitations, and future trends in AM.

Course outcomes: At the end of the course, the student will be able to

1. Understand the basic principles and classifications of additive manufacturing processes.
2. Select appropriate AM processes and materials for different applications.
3. Analyze design considerations specific to additive manufacturing.
4. Evaluate the performance and limitations of various AM techniques.
5. Apply additive manufacturing knowledge in product development and industrial applications.

UNIT–I: Introduction to AM

Prototyping Fundamentals: Need For Time Compression in Product Development, Need for Additive Manufacturing, Historical Development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly Used Terms, Classification of AM Process, Fundamental Automated Processes: Distinction Between AM and CNC, Other Related Technologies.

UNIT–II: Liquid and Solid-Based AM Systems

Liquid-Based AM Systems: Stereo Lithography Apparatus (SLA): Models and Specifications, Process, Working Principle, Photopolymers, Photo Polymerization, Layering Technology, Laser and Laser Scanning, Applications, Advantages and Disadvantages, Case Studies. Solid Ground Curing (SGC): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Poly Jet: Process, Principle, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Micro Fabrication.
Solid-Based AM Systems: Laminated Object Manufacturing (LOM): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Fused Deposition Modeling (FDM): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Multi-Jet Modelling (MJM): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies.

UNIT–III: **Powder-Based AM and Rapid Tooling**

Powder-Based AM Systems: Selective Laser Sintering (SLS): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Three-Dimensional Printing (3DP): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies.
Laser Engineered Net Shaping (LENS): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Electron Beam

Melting (EBM): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies
Rapid Tooling: Introduction To Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool Process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process, and Direct Metal Tooling Using 3DP.

UNIT–IV: AM Data Formats and Software
AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequences of Building Valid and Invalid Tessellated Models, STL File Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Subdivision Techniques.
AM Software's: Need For AM Software, Features of Various AM Software's, Like Magics, Mimics, Solid View, View Expert, 3D View, Velocity 2, Rhino, STL View 3, Data Expert, and 3D Doctor, Surgi Guide, 3-Matic, Simplant, Mesh Lab.

UNIT–V: Industrial and Medical AM Applications
Applications of AM, Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS Application, Arts and Architecture.
RP Medical and Bioengineering Applications: Planning and Simulation of Complex Surgery, Customized Implants and Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web-Based Rapid Prototyping Systems

TEXTBOOK:

1. Rapid Prototyping: Principles and Applications, Chee Kai Chua, Kah Fai Leong, and Chu Sing Lim, World Scientific Publishing Co, Third Edition, 2010.
2. Additive Manufacturing: Materials, Processes, Quantifications and Applications, Kun Zhou, CRC Press, 1st Edition, 2021.

REFERENCE BOOKS:

1. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D. T. Pham and S. S. Dimov, Springer, 1st Edition 2001.
2. Wohlers Report 2000: Rapid Prototyping and Tooling State of the Industry, Terry T. Wohlers, Wohlers Associates, Fort Collins, CO, Annual Report, 2000.
3. Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press, 2nd Edition, 2019.
4. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W. Rosen, Brent Stucker, Springer, 2nd Edition, 2015.
5. Additive Manufacturing: Design, Methods, and Processes, Andreas Gebhardt, Hanser Publishers, 2nd Edition, 2016.
6. Fundamentals of Additive Manufacturing for the Practitioner, Sheku Kamara, Javarro Russell, Klaus-Dieter Thoben, Wiley, 1st Edition, 2021.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
ADVANCED FINITE ELEMENT AND BOUNDARY ELEMENT METHODS
(Professional Elective - I)

L	T	P	C
3	0	0	3

Prerequisite: Strength of Materials, Mathematics, Heat Transfer and Vibrations.

Course Objectives:

1. To introduce the basic concepts of the finite element method, the boundary element method.
2. To formulate and solve problems in 1D, 2D, and 3D using FEM.
3. To introduce BEM and its application in linear problems.
4. To study the numerical integration and solution techniques used in FEM/BEM.
5. To expose students to software tools implementing FEM/BEM techniques.

Course outcomes: After completing this course, the student should be able to

1. Formulate and solve engineering problems using FEM and BEM.
2. Apply FEM to structural, thermal, and fluid flow problems.
3. Use boundary element formulation for linear problems with infinite domains.
4. Implement numerical methods to solve FEM/BEM equations.
5. Utilize commercial software for simulation and result interpretation.

UNIT–I: Finite Element Analysis of 1D Structural Members

One-Dimensional Problems: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic Shape Functions.

Analysis of Trusses: Derivation of Stiffness Matrix for a Truss Element oriented Arbitrarily to a 2D plane, Calculation of Reaction Forces, Displacements, Stresses, and Strains.

Analysis of Beams: Derivation of Stiffness Matrix for Two-Noded, Two Degrees of Freedom Per Node Beam Element, Load Vector, Deflection, Stresses, Shear Force and Bending Moment, Problems on Uniform and Stepped Beams for Different Types of Loads Applied on Beams.

UNIT–II: 2D and 3D Structural Element Analysis in FEA

Finite Element Formulation of 2D Problems: Derivation of Element Stiffness Matrix for Two-Dimensional CST Element, Derivation of Shape Functions for CST Element, Elasticity Equations, Constitutive Matrix Formulation, Formulation of Gradient Matrix, Two-Dimensional Iso parametric Elements and Numerical Integration, Problems.

Finite Element Formulation of 3D Problems: Derivation of Element Stiffness Matrix for Tetrahedron Element, Properties of Shape Functions for 3D Tetrahedral Element, Stress-Strain Analysis for 3D Element, Strain - Displacement Relationship Formulation.

UNIT–III: Thermal and Dynamic Analysis in FEA

Steady State Heat Transfer Analysis: One-Dimensional Finite Element Analysis of Fin and Composite Slabs.

Two-Dimensional Steady State Heat Transfer Problems: Derivation of Thermal Stiffness Matrix for 2D Heat Transfer Problems-CST, Derivation of Thermal Force Vector for 2D Heat Transfer Problems.

Dynamic Analysis: Formulation of Mass Matrices for Uniform Bar and Beam Elements using Lumped and Consistent Mass Methods, Evaluation of Eigen Values and Eigen Vectors for a Stepped Bar and Beam Problems.

UNIT–IV: Plate Bending and Nonlinear FEA of Solids

Plate Bending: Introduction, Plate Behavior, C^1 (Kirchhoff) Plate Elements, C^0 (Mindlin) Plate Elements, Mindlin Beam, More Devices for C^0 Plate Elements, Boundary Conditions, Analytical Problems.

Nonlinear Finite Element of Solids: Material Nonlinearities, Objective Rates, Nonlinear Elasticity, Plasticity, Viscoplasticity, Viscoelasticity.

UNIT–V: Boundary Element Method for Potential and Electrostatic Problems

Boundary Element Method: Potential Problems: Introduction, Boundary Element Approach, Fundamental Solution, Numerical Implementation, Determination of Ci, Final Relation, Three-Dimensional Analysis, Tackling Kernel Singularity.

Boundary Element Formulation for Electrostatic Problems: Introduction, Basic Relation, Boundary Condition and Other Relations, Discretization and Matrix Formulation, Determination of Term C(p)m.

TEXT BOOKS:

1. The finite element methods in Engineering, S.S. Rao, Elsevier, 4th Edition, 2005.
2. Finite and Boundary Element Methods in Engineering, O.P. Gupta, Oxford and IBH Publishing Co. Pvt. Ltd., 1st Edition, 1991.

REFERENCE BOOKS:

1. Finite Element Methods: Basic Concepts and Applications, Alavala Chennakesava R. PHI, 3rd Edition, 2012.
2. Introduction to Finite Elements in Engineering, Tirupathi R. Chandrupatla and Ashok D. Belegundu, Pearson Education, 4th Edition, 2011.
3. An Introduction to Finite Element Methods, J. N. Reddy, McGraw-Hill Education, 3rd Edition, 2005.
4. The Finite Element Method in Engineering Science, O.C. Zienkowitz, McGraw-Hill, 1st Edition, 1971.
5. A First Course in Finite Elements, Jacob Fish and Ted Belytschko, Wiley, 1st Edition, 2007.
6. Fundamentals of Finite Element Analysis, David Hutton, McGraw-Hill Education, 1st Edition, 2004.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, I Semester

EXPERIMENTAL STRESS ANALYSIS

(Professional Elective - I)

L	T	P	C
3	0	0	3

Prerequisite: Strength of Materials, Theory of Elasticity (desirable).

Course objectives:

1. Introduce the basic principles and methods of experimental stress analysis.
2. Provide an in-depth understanding of strain measurement using electrical and mechanical strain gauges.
3. Familiarize students with photoelasticity techniques and fringe interpretation in two and three dimensions.
4. Explore advanced optical methods and model analysis using structural similitude and dimensional analysis.
5. Introduce specialized experimental techniques and non-destructive testing (NDT) methods such as ultrasonic, X-ray, and brittle coating techniques.

Course Outcomes: At the end of the course, students will be able to

1. Understand the working principles of strain gauges and perform model analysis using theorems like Buckingham Pi and Muller-Breslau's.
2. Explain the fundamentals and applications of photo elasticity in 2D and 3D stress analysis.
3. Utilize various optical and mechanical tools for experimental stress measurement and validation.
4. Apply non-destructive testing techniques like ultrasonic testing, X-ray, gamma-ray, rebound hammer, and Moiré fringe methods for material evaluation.
5. Design experimental setups using model analysis, strain measurement, and advanced optical techniques to evaluate stress distribution in mechanical structures.

UNIT- I: Strain Measurement Techniques

Strain Gauges, Mechanical and Optical Strain Gauges, Description and Operation, Electrical Resistance, Inductance and Capacitance Gauges, Detailed Treatment on Resistance Gauges, Measurement of Static and Dynamic Strains, Strain Rosettes, Effect of Transverse Strains, Use of Strain Recorders and Load Cells.

UNIT- II: Model Analysis and Structural Similitude

Model Analysis, Structural Similitude, Use of Models, Structural and Dimensional Analysis, Buckingham Pi Theorem, Muller-Breslau's Principle for Indirect Model Analysis, Use of Begg's and Eney's Deformer's, Moment Indicators, Design of Models for Direct and Indirect Analysis.

UNIT- III: Photoelasticity and Optical Methods

Two-Dimensional Photo elasticity, Stress Optic Law, Introduction to Polariscope, Plane and Circular Polariscope, Compensators and Model Materials, Material and Model Fringe Value, Calibration of Photo elastic Materials, Isochromatic and Isoclinic Fringes, Time Edge Effects.

UNIT - IV: 3D Photo elasticity and Advanced Optical Analysis

Three-Dimensional Photoelasticity, Introduction, Stress Freezing Techniques, Stress Separation Techniques, Scattered Light Photoelasticity, Reflection Polariscope.

UNIT - V: Specialized and Non-Destructive Testing

Miscellaneous Methods, Brittle Coating Method, Birefringence Techniques, Moiré Fringe Method, Non-Destructive Testing, Ultrasonic Pulse Velocity Technique, Rebound Hammer Method, X-Ray Method, Gamma-Ray Method.

TEXT BOOKS:

1. Experimental Stress Analysis, J.W. Dally and W.F. Riley, McGraw-Hill, 2nd Edition, 1991.
2. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers / Dhanpat Rai Publications, Revised Edition, 2009.

REFERENCES:

1. Experimental Stress Analysis, Sadhu Singh, Dhanpat Rai Publications, Revised Edition, 2009.
2. Handbook of Experimental Stress Analysis, Max Hetenyi, John Wiley and Sons, New York, 1st Edition, 1950.
3. Photoelasticity, M.M. Frocht, Vol. I and II, John Wiley and Sons, New York, 1st Edition, 1941 (Vol. I) and 1948 (Vol. II).
4. C. Rama Rao, Experimental Stress Analysis, University Press, 1st Edition, 2013.
5. N. Ramesh Babu, Experimental Stress Analysis: Principles and Practice, Anuradha Publications, 1st Edition, 2008.
6. R.K. Rajput, Strength of Materials (For NDT and Stress Analysis Reference), S. Chand and Company, Revised Edition, 2015.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, I Semester

SUSTAINABLE MANUFACTURING

(Professional Elective - I)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes, Environmental Science

Course Objectives:

1. To understand the principles and need for sustainability in manufacturing.
2. To study methods for reducing energy, material waste, and emissions.
3. To explore sustainable product design, green supply chains, and life cycle analysis.
4. To introduce eco-friendly manufacturing technologies and metrics.
5. To promote decision-making frameworks for sustainability in industry.

Course Outcomes: Upon completion of this course, the student will be able to:

1. Explain the core concepts of sustainable manufacturing.
2. Analyze manufacturing processes for environmental impacts.
3. Apply life cycle assessment tools in product and process design.
4. Integrate sustainability principles in supply chain and resource management.
5. Recommend sustainable strategies for various manufacturing systems.

UNIT-I: Fundamentals of Sustainability

Concepts of Sustainability and Sustainable Development, Need For Sustainable Development, Components of Sustainability, Social, Economic, and Environmental Dimensions, Linkages Between Technology and Sustainability, Sustainable Manufacturing, Scope, Need, and Benefits.

UNIT-II: Sustainable Manufacturing Tools

Tools and Techniques of Sustainable Manufacturing, Environmental Conscious Quality Function Deployment, Life Cycle Assessment, Design for Environment, R3 and R6 Cycles, Design for Disassembly, Sustainable Product Development, and Various Phases.

UNIT-III: Environmental Assessment and Standards

EIA Methods, CML, EI 95 and 99, ISO 14001 EMS and PAS 2050 Standards, Environmental Impact Parameters, Interactions between Energy and Technology, and their Implications for Environment and Sustainable Development.

UNIT-IV: Sustainable Product Design

Design for Recycling, Eco-Friendly Product Design Methods, and Methods to infuse sustainability in early Product Design Phases, Multi-Criteria Decision Making in Sustainability.

UNIT-V: Sustainability Metrics and Corporate Responsibility

Frameworks for Measuring Sustainability, Indicators of Sustainability, Environmental, Economic, Societal, and Business Indicators, Concept Models and Various Approaches, Product Sustainability and Risk / Benefit Assessment, Corporate Social Responsibility.

TEXT BOOK:

1. Industrial Development for the 21st Century: Sustainable Development Perspectives, D. Rodick, United Nations, Department of Economic and Social Affairs, 1st Edition, 2007.
2. Sustainable Manufacturing and Design, Kaushik Kumar, J. Paulo Davim, Apple Academic Press, 1st Edition, 2021.

REFERENCE BOOKS:

1. Sustainability in Manufacturing, Günther Seliger, Springer, 1st Edition, 2007.
2. Sustainable Manufacturing: Challenges, Solutions and Implementation Perspectives, R. Stark, G. Seliger and J. Bonvoisin, Springer, 1st Edition, 2017.
3. Handbook of Sustainable Manufacturing, G. Atkinson, S. Dietz, E. Neumayer, Edward Elgar Publishing Limited, 1st Edition, 2007.
4. Green Manufacturing: Fundamentals and Applications, David A. Dornfeld, Springer, 1st Edition, 2013.
5. Sustainable Manufacturing: Industrial Engineering Perspective, S. Vinodh, CRC Press, 1st Edition, 2021.
6. Sustainable Manufacturing Processes: Selected Challenges and Case Studies, R. Golinska-Dawson and A. Kolinski, Springer, 1st Edition, 2020.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, I Semester

L	T	P	C
3	0	0	3

AUTOMATION IN MANUFACTURING

(Professional Elective - II)

Prerequisites: Production Technology, Machine Tools, Operations Research

Course Objectives:

1. To introduce the basics of automation and its classification in manufacturing systems.
2. To understand control systems, types of automation, and their hardware components.
3. To analyze automated material handling, storage, and inspection systems.
4. To study transfer mechanisms and principles of system integration.
5. To evaluate economic aspects and strategies of implementing manufacturing automation.

Course Outcomes: Upon completion of this course the student will be able to:

1. Classify different types of automation and describe their roles in modern manufacturing.
2. Analyze discrete and continuous control systems used in automation.
3. Design material handling systems and storage solutions for automated facilities.
4. Understand inspection systems, transfer mechanisms, and integration methods.
5. Apply cost analysis and automation strategies in real-world manufacturing contexts.

UNIT-I: Introduction to Automation

Automation in Production Systems, Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing Operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated System, Advanced Automation Functions, and Levels of Automation.

UNIT-II: Material Handling

Introduction, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and Other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, and Engineering Analysis of Storage Systems. Automatic Data Capture, Overview of Automatic Identification Methods, Bar Code Technology, and Other ADC Technologies.

UNIT -III: Manual Assembly Lines

Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line Balancing Problem, Largest Candidate Rule, Kilbridge and Wester Method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, and Considerations in Assembly Line Design.

UNIT-IV: Transfer lines

Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with No Internal Storage, Analysis of Transfer Lines with Storage Buffers.

UNIT-V: Automated Assembly Systems

Fundamentals of Automated Assembly Systems, Design for Automated Assembly and Quantitative Analysis of Assembly Systems, Parts Delivery System at Workstations, Multi-Station Assembly Machines and Single-Station Assembly Machines, Partial Automation.

TEXTBOOKS:

1. Automation, Production Systems and computer integrated manufacturing, Mikel P. Groover, Pearson Education, 4th Edition, 2015.
2. CAD/CAM: Principles, Practice and Manufacturing Management, Chris Mc Mohan, Jimmie Browne, Pearson Edu. (LPE), 2nd Edition, 2000.

REFERENCE BOOKS:

1. Automation, Buckingham W, Haper and Row Publishers, New York, 3rd Edition, 1961.
2. Automation for Productivity, Hugh D. Luke, A Becker, and Hayes publication, New York, 1st Edition, 1972.
3. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson Education, 5th Edition, 2023.
4. Computer Control of Manufacturing Systems, Yoram Koren, McGraw-Hill, 1st Edition, 1983.
5. Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design, Yusuf Altintas, Cambridge University Press, 2nd Edition, 2012.
6. Industrial Automation: Hands On, Frank Lamb, McGraw-Hill Education, 1st Edition, 2013.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
COMPUTER AIDED PROCESS PLANNING
(Professional Elective - II)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Technology, Computer-Aided Design (CAD)

Course Objectives:

1. To introduce the principles and methods of process planning in manufacturing systems.
2. To understand the role of computers in automating and optimizing process planning.
3. To explore variant and generative process planning approaches.
4. To integrate computer-aided process planning (CAPP) with CAD, CAM, and MRP systems.
5. To examine the benefits, challenges, and implementation of CAPP in industry.

Course Outcomes: Upon completion of this course, the student will be able to:

1. Explain the fundamentals of manual and computer-aided process planning.
2. Differentiate between variant and generative CAPP systems.
3. Apply group technology and coding systems for process planning.
4. Integrate CAPP with CAD/CAM and production control systems.
5. Design and evaluate CAPP solutions for efficient and automated manufacturing planning.

UNIT- I: Concepts of Process Planning

The Place of Process Planning in the Manufacturing Cycle, Process planning and production Planning, Process planning and Concurrent Engineering, CAPP, Group Technology.

UNIT- II: Part Design and Representation

Design, Drafting, Dimensioning, Conventional Tolerance, Geometric Tolerance, CAD, Input/Output Devices, Topology, Geometric Transformation, Perspective Transformation, Data Structure, Geometric Modelling For Process Planning, GT Coding, The OPITZ System, The MICLASS System, Problems.

UNIT- III: Process Engineering and Planning Methods

Experience Based Planning, Decision Table and Decision Trees, Process Capability Analysis, Process Planning, Variant Process Planning, Generative Approach, Forward and Backward Planning, Input Format, AI, Problems.

UNIT- IV: Process Planning Systems

Logical Design of Process Planning, Implementation Considerations, Manufacturing System Components, Production Volume, No. of Production Families, CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP, Problems.

UNIT-V: Integrated Process Planning Systems

Totally Integrated Process Planning Systems: An Overview, Modulus Structure Data Structure, Operation, Report Generation, Expert Process Planning, Problems.

TEXT BOOKS:

1. Principle of process planning - A Logical Approach, Ideon Halevi and Roland D. Weill, Chapman and Hall, 1st Edition, 1995
2. An Introduction to Automated Process Planning Systems, Chang T. C. and Richard A. Wysk, Prentice Hall, 1st Edition, 1985.

REFERENCES:

1. An Expert Process Planning System: Fundamentals of Computer-Aided Process Planning, T.C. Chang, Prentice Hall, 1st Edition, 1985.
2. Systems Approach to Computer Integrated Design and Manufacturing, Nanua Singh, John Wiley and Sons, 1st Edition, 1996.
3. Computer Aided Manufacturing, P.N. Rao, Tata McGraw Hill Publishing Co., 2nd Edition, 2000.
4. Computer-Aided Manufacturing, Rao P.N., Tata McGraw Hill, 4th Edition, 2013.
5. Process Planning and Cost Estimation, R. Kesavan, C. Elanchezhian, and B. Vijaya Ramnath, New Age International, 2nd Edition, 2010.
6. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson, 4th Edition, 2014.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, I Semester

INDUSTRIAL ROBOTICS

(Professional Elective - II)

L	T	P	C
3	0	0	3

Prerequisites: Kinematics of machinery

Course Objectives:

1. To introduce the fundamentals of industrial robotics and robot configurations.
2. To analyze forward and inverse kinematics of robotic manipulators.
3. To study robot dynamics, end effectors, and machine vision systems.
4. To learn robot programming, control techniques, and path planning.
5. To explore industrial applications of robotics in manufacturing and automation.

Course Outcomes: After doing this course, the student will be able to,

1. Understand robot structures, drive systems, sensors, and actuators.
2. Perform kinematic and dynamic analysis of robotic arms.
3. Evaluate and apply vision systems for robotic inspection and control.
4. Develop robot programs using different programming methods.
5. Design robotic cells for manufacturing tasks and analyze their performance.

UNIT-I: Robot Basics and Sensors

Introduction, Automation and Robotics, Robot Anatomy Configuration, Motions, Joint Motion and Notation, Work Volume, Robot Drive System, Control System and Dynamic Performance, Precision of Movement.

Control System and Components: Basic Concept and Modal Controllers Control System Analysis, Robot Actuators and Feedback Components (Sensors): Internal and External Sensors, Position Sensors, Velocity Sensors, Desirable Features, Tactile, Proximity and Range Sensors, Uses Sensors in Robotics, Power Transmission Systems.

UNIT-II: Motion Analysis and Control

Manipulator Kinematics, Position Representation, Homogeneous Transformation, D-H Notation, D-H Transformation Matrix, Forward and Inverse Transformations, Problems on Planar and Spatial Manipulators, Differential Kinematics, Jacobian Formulation, Problems. Manipulator Path Control: Slew, Joint Interpolated and Straight-Line Motions. Trajectory Planning: Joint Space Scheme, Cartesian Space Scheme, Cubic Polynomial Fit Without and with Via Point, Blending, Problems.

UNIT-III: Dynamics, End Effectors and Vision

Robot Dynamics: Lagrange – Euler and Newton - Euler formulations, problems on two-link planar manipulators, configuration of robot controller, Problems.

End Effectors: Gripper types, operation, mechanism, force analysis, tools as end effectors, consideration in gripper selection and design.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT-IV: Robot Programming and Languages

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, Wait, Signal and Delay commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT-V: Work Cell Design and Applications

Robot Cell Design and Control: Robot cell layouts, Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.

Robot Applications: Material transfer, Machine loading, unloading. Processing operations, Assembly and Inspection, Future Applications.

TEXT BOOKS:

1. Introduction to Robotics Mechanics and Control, John J. Craig, Pearson Education, 3rd Edition, 2005.
2. Industrial Robotics: Technology, Programming, and Applications, Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, McGraw-Hill, 1st Edition, 1986.

REFERENCE BOOKS:

1. Robotics: Control, Sensing, Vision and Intelligence, K. S. Fu and R. C. Gonzalez and C. S. G. Lee, McGraw-Hill Education, 2nd Edition, 2023.
2. Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Lung-Wen Tsai, John Wiley and Sons, 2nd Edition, 2022.
3. Robot Analysis and Control, H. Asada and J. E. Slotine, Wiley, 2nd Edition, 2021.
4. Fundamentals of Robotics: Analysis and Control, Robert J. Schilling, Pearson Education, 2nd Edition, 2022.
5. Robotics for Engineers, Yoram Koren, McGraw-Hill Education, 2nd Edition, 2023.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

Prerequisite: Fundamentals of Statistics, Technical Writing Skills

Course Objectives:

1. To understand research fundamentals, methodologies, and the significance of research ethics.
2. To enable students to formulate research problems and conduct literature surveys effectively.
3. To introduce the principles of data collection, analysis, and interpretation in research.
4. To explain intellectual property rights, patents, copyrights, and trademarks.
5. To highlight the importance of IPR in protecting innovative ideas and research outcomes.

Course Outcomes: At the end of this course, students will be able to

1. Understand the research process, methodologies, and ethics involved in scholarly work.
2. Formulate and define research problems with appropriate objectives.
3. Apply suitable data collection and analysis techniques for research projects.
4. Understand the various forms of intellectual property rights and legal aspects related to patents and copyrights.
5. Apply the knowledge of IPR to safeguard their innovations and research findings.

UNIT-I: Research Problem and Investigation Approaches

Meaning of Research Problem, Sources of Research Problem and Criteria Characteristics of a Good Research Problem, Errors in Selecting a Research Problem, Scope and Objectives of Research Problem. Approaches of Investigation of Solutions for Research Problem, Data Collection, Analysis, Interpretation, Necessary Instrumentations.

UNIT-II: Literature Review and Ethics

Effective Literature Studies Approaches, Analysis, Plagiarism, Research Ethics.

UNIT-III: Technical Writing and Proposals.

Effective Technical Writing, How to Write Report, Paper Developing a Research Proposal, Format of Research Proposal, a Presentation and Assessment by A Review Committee.

UNIT-IV: Intellectual Property and Patenting

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process Of Patenting and Development: Technological Research, Innovation, Patenting, Development. International Scenario: International Cooperation on Intellectual Property. Procedure for Grants of Patents, Patenting Under PCT.

UNIT-V: Patent Rights and Emerging IPR

Patent Rights: Scope of Patent Rights, Licensing and Transfer of Technology, Patent Information and Databases, Geographical Indications. New Developments in IPR: Administration of Patent System. IPR of Biological Systems, Computer Software Etc., Traditional Knowledge Case Studies, IPR and IITs.

TEXTBOOKS:

1. Research methodology: an introduction for science and engineering students, Stuart Melville and Wayne Goddard, Juta and Co. Ltd, 1ST Edition, 1996.
2. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, SAGE, 2nd Edition, 2010.

REFERENCE BOOKS:

1. Resisting Intellectual Property, Debora J. Halbert, Routledge, Taylor and Francis, 1st Edition, 2005.
2. Industrial Design, W. H. (William Henry) Mayall, Iliffe Books (London), also McGraw-Hill editions, 1st Edition, 1974.
3. Intellectual Property in the New Technological Age, Robert P. Merges, Peter S. Menell and Mark A. Lemley, Aspen Casebook Series, Latest Edition, 2016.
4. Intellectual Property Rights under WTO, T. Ramappa, Wheeler Publishing, 1st Edition, 2000.
5. Research Methodology and IPR, P. N. Ganesan, SciTech Publications, 1st Edition, 2019.
6. Intellectual Property Rights: Unleashing the Knowledge Economy, Prabuddha Ganguli, Tata McGraw-Hill, 1st Edition, 2001.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
ADVANCED COMPUTER AIDED DESIGN LAB

L	T	P	C
0	0	4	2

Prerequisites: Computer Aided Design, Engineering Graphics

Course Objectives:

1. Provide hands-on training in 2D and 3D modeling using CAD software tools.
2. Familiarize students with dimensioning, geometric tolerancing, and virtual product design.
3. Enable students to perform structural, dynamic, and advanced simulations using FEA software.
4. Develop skills in simulating real-world mechanical problems such as stress, vibration, buckling, and failure.
5. Integrate theoretical knowledge with practical applications through projects involving static and dynamic FEA analysis.

Course Outcomes: After successful completion of this course, students will be able to,

1. Create accurate 2D and 3D models of mechanical components using CAD tools.
2. Apply dimensioning and tolerance techniques to enhance design clarity and manufacturability.
3. Assemble components virtually and simulate simple mechanisms with motion/animation features.
4. Perform structural analysis of trusses, beams, and frames using FEA tools.
5. Analyze advanced mechanical behavior including buckling, vibration, and fracture using FEA**.**

List of Experiments:

1. Two-Dimensional Drawing Using CAD Software.
2. Three-Dimensional Drawing Using CAD Software.
3. Various Dimensioning and Tolerance Techniques on Typical Products Using CAD Software.
4. Assembly and Animation of Simple Assemblies like Screw Jack, Bolt-Nut Mechanism, Etc.
5. Truss Analysis Using FEA Software.
6. Beam Analysis Using FEA Software.
7. Frame Analysis Using FEA Software.
8. Buckling Analysis of Columns Using FEA Software.
9. Harmonic Analysis Using FEA Software.
10. Fracture Analysis Using FEA Software.
11. Analysis of Laminated Composites Using FEA Software.
12. Couple-Field Analysis Using FEA Software.
13. Modal Analysis
14. Transient Dynamic Analysis
15. Spectrum Analysis.

Note: Conduct any 12 out of 15 exercises from the list of Experiments:

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
ADDITIVE MANUFACTURING LAB

L	T	P	C
0	0	4	2

Prerequisites: Manufacturing Processes, Engineering Drawing and CAD Modeling

Course Objectives:

1. To provide hands-on experience with additive manufacturing technologies.
2. To train students in CAD modeling and preparation of STL files for 3D printing.
3. To demonstrate operation and troubleshooting of 3D printers.
4. To develop skills in post-processing and inspection of printed components.
5. To expose students to material selection, process planning, and applications of additive manufacturing.

Course Outcomes: After successful completion of this course, students will be able to:

1. Prepare 3D CAD models and convert them into printable formats.
2. Operate and calibrate different types of additive manufacturing machines.
3. Select appropriate materials and parameters for specific applications.
4. Inspect and evaluate quality of printed parts through dimensional and visual checks.
5. Understand practical challenges and applications of additive manufacturing in real-world scenarios.

List of Experiments:

1. Review of CAD Modeling Techniques and Introduction to RP
2. Forming Groups and Assigning Creative Idea
3. Generating STL files from the CAD Models and Working on STL files
4. Modeling Creative Designs in CAD Software
5. Assembling Creative Designs in CAD Software
6. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7. Simulation in Catalyst Software
8. Print 3D Models Plates
9. 3D Models - Simple 3D Objects
10. Printing of Cellular Structure
11. Strength and Energy Absorption Characteristics using UTM

Note: Conduct any 10 out of 11 exercises from the list given above.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
COMPUTER INTEGRATED MANUFACTURING
(Professional Core – III)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes, Production Technology and CAD/CAM

Course Objectives: To make the students

1. To understand the role of computers in manufacturing.
2. To provide an in-depth understanding of manufacturing and database systems.
3. To provide an understanding of the needs of the market and design the product.
4. To design and develop material handling, storage and retrieval systems for specific cases of manufacturing.
5. To develop CIM systems for current manufacturing scenario by using computer and networking tools.

Course Outcomes: At the end of the course, students will be able to

1. Select the necessary computing tools for the development of products.
2. Use appropriate database systems for manufacturing a product and store the same for future use.
3. Apply the latest technology of manufacturing systems and software for the development of a product.
4. Use modern manufacturing techniques and tools including principles of networking.
5. Apply the concepts of lean manufacturing and agile manufacturing.

UNIT – I: Concepts of CIM

The meaning of Manufacturing, Types of Manufacturing; CIM Definition, Elements of CIM, CIM wheel, Concept or Technology, Evolution of CIM, Benefits of CIM, Needs of CIM, Hardware and software, Fundamentals of Communication, Communications Matrix, Product Development Cycle. Concurrent Engineering: Definition, Sequential Engineering versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of Concurrent Engineering, Framework for Integration of Life Cycle Phases in CE, Concurrent Engineering Techniques, Integrated Product Development (IPD), Product Life Cycle Management (PLM), Collaborative Product Development.

UNIT – II: Database Systems and PDM

Introduction to Manufacturing Data, Types, Sources, Database Terminology, Database Requirements, Database Models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL), Basic structure, Data Definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (Store, Retrieve, Update, Delete).
Illustration of Creating and Manipulating a Manufacturing Database, SQL as a Knowledge Base Query Language, Features of Commercial DBMS, Oracle, MySQL, SQL Access, Sybase, DB2, Product Data Management (PDM), Advantages of PDM.

UNIT – III: Product and Manufacturing Systems

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly.

Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II).

Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine Component Group Analysis, Similarity Coefficients- Based Approaches, Evaluation of Cell Design.

Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS, Types of Flexibility. Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout, Operational Problems of FMS. FMS benefits.

UNIT – IV: Networking and CIM Models

Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN. Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods. Network Architectures and Protocols: OSI Model, MAP and TOP, TCP, IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise, wide Integration.

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT – V: Lean Manufacturing:

Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web-Based Manufacturing systems.

TEXT BOOKS:

1. Principles of Computer Integrated Manufacturing, S.Kant Vajpayee, Prentice Hall India, 1st Edition, 1998.
2. Systems Approach to Computer Integrated Design and Manufacturing, Nanua Singh, John Wiley and Sons, Inc, 1st edition, 1995.

REFERENCE BOOKS:

1. CAD, CAM, CIM, P. Radhakrishnan, S. Subramanyam and V. Raju, New Age International Pvt Ltd, 4th Edition, 2016.
2. Computer Integrated Manufacturing, A. Alavudeen and N. Venkateshwaran, Prentice Hall India Learning Pvt Ltd, 1st Edition, 2010.
3. Manufacturing Planning and Control for Supply Chain Management, F. Robert Jacobs and William Lee Berry, McGraw-Hill Education, 7th Edition, 2023.
4. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson Education, 5th Edition, 2023.
5. Manufacturing Systems Engineering, Stanley B. Gershwin, Prentice Hall, 2nd Edition, 2022.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
MANUFACTURING SYSTEMS: SIMULATION MODELLING AND ANALYSIS
(Professional Core – IV)

L	T	P	C
3	0	0	3

Prerequisites: Operations Research, Optimization Techniques, Probability Statistics

Course Objectives:

1. Learn ways of analyzing the systems.
2. Classification of systems-based nature of dynamics and knowledge of elements.
3. To develop simulation model for dynamic discrete – event stochastic system.
4. To run the model and collect the data.
5. To analyze the output data of simulation for specified for performance measures based on type of simulation and method of output data analysis.

Course Outcomes: At the end of course, students should be able to

1. Define the state of system W.R.T specified performance measures.
2. Develop simulation model for the said system
3. Generate random variations and learn various simulation languages.
4. Analyze through simulation the model and present the results to specified confidence level.
5. Apply simulation for flow shop systems and job shop systems.

UNIT - I: System Modeling and Statistical Analysis

System Analysis, Ways to Analyze the System, Model, Types of Models, Simulation, Definition, Types of Simulation Models, Steps Involved in Simulation, Advantages and Disadvantages. Parameter Estimation, Estimator, Properties Estimate, Point Estimate, Confidence Interval Estimates, Independent, Dependent, Hypothesis, Types of Hypotheses, Steps, Types 1 and 2 Errors, Framing, Strong Law of Large Numbers.

UNIT - II: Model Validation and Stochastic Inputs

Building of Simulation Model, Validation, Verification, Credibility their Timing, Principles of Valid Simulation Modeling, Techniques for Verification, Statistical Procedures for Developing Credible Model. Modeling of Stochastic Input Elements, Importance, Various Procedures, Theoretical Distribution, Continuous, Discrete their Suitability in Modeling.

UNIT - III: Random Variate Generation and Simulation Languages

Generation Of Random Variates, Factors for Selection, Methods, Inverse Transform, Composition, Convolution, Acceptance, Rejection, Generation of Random Variable, Exponential, Uniform, Weibull, Normal, Bernoulli, Binomial Uniform Poison. Simulation Languages, Comparison of Simulation Languages with General Purpose Languages, Simulation Languages vs Simulators, Software Features, Statistical Capabilities, GPSS, SIMAN, SIMSCRIPT, Simulation of M-M-1 Queue, Comparison of Simulation Languages.

UNIT - IV: Output Data Analysis and Steady-State Simulation

Output Data Analysis, Types of Simulation with Respect to Output Data Analysis, Warm Up Period, Welch Algorithm, Approaches for Steady State Analysis, Replication, Batch Means Methods, Comparisons.

UNIT –V: Simulation Applications in Manufacturing

Applications of Simulation, Flow Shop System, Job Shop System M/M/1 Queues with Infinite and Finite Capacities, Simple Fixed Period Inventory System, New Boy Paper Problem.

TEXT BOOKS:

1. Simulation Modelling and Analysis by Law, A.M. and Kelton, McGraw-Hill, 2nd Edition, 1991.
2. Discrete-Event System Simulation, Jerry Banks and John S. Carson II, Prentice-Hall, 1st Edition, 1984.

REFERENCE BOOKS:

1. Simulation of Manufacturing Systems, Allan Carrie, John Wiley and Sons, Chichester and New York, 1st Edition, 1988.
2. A Course in Simulation, Sheldon M. Ross, Macmillan Publishing Company, 1st Edition, 1990.
3. Simulation Modeling and SIMNET, H. A. Taha, Prentice Hall, 1st Edition, 1988.
4. Modeling and Simulation of Discrete Event Systems, Byoung Kyu Choi and DongHun Kang, Wiley, 2nd Edition, 2023.
5. Introduction to Simulation Using Simulink, Michael A. Dwyer, Springer, 1st Edition, 2023.
6. Simulation with Any Logic, Andrei Borshchev, Springer, 2nd Edition, 2021.
7. Manufacturing Systems Modeling and Analysis, Guy L. Curry and Richard M. Feldman, Pearson Education, 2nd Edition, 2023.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, II Semester

INTELLIGENT MANUFACTURING SYSTEMS

(Professional Elective – III)

L	T	P	C
3	0	0	3

Prerequisites: Computer Integrated Manufacturing, Artificial Intelligence Basics

Course Objectives:

1. To understand the computer integrated manufacturing systems
2. To provide an in-depth understanding of components of knowledge-based systems
3. To provide an understanding of artificial intelligence
4. To design and develop automated process planning
5. To develop group technology for intelligent manufacturing systems.

Course outcomes: After completing this course, the student will be able to

1. Select the necessary tools for computer-integrated manufacturing systems
2. Use appropriate knowledge of components of knowledge-based systems
3. Use machine learning techniques for intelligent manufacturing systems
4. Apply the concepts of automated process planning
5. Apply the group technology for intelligent manufacturing systems.

UNIT - I: Computer Integrated Manufacturing System

Computer Integrated Manufacturing Systems: Structure and Functional Areas of CIM System, CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM, Manufacturing Communication Systems, MAP / TOP, OSI Model, Data Redundancy, Top-Down and Bottom-Up Approach, Volume of Information, Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT - II: Knowledge-Based System Components and Representation

Components of Knowledge-Based Systems, Basic Components of Knowledge-Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT - III: Artificial Intelligence and Neural Networks in Manufacturing

Machine Learning, Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks, Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT - IV: Automated Process Planning and Equipment Selection

Automated Process Planning, Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process Planning, Knowledge-Based System for Equipment Selection (KBSES), Manufacturing System Design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem-Solving Approach in KBSES, Structure of the KRSES.

UNIT - V: Group Technology and Knowledge Based Clustering

Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation, Similarity Coefficient Method, Sorting-Based Algorithms, Bond Energy Algorithm, Cost Based Method, Cluster Identification Method, Extended CI Method, Knowledge Based Group Technology, Group Technology in Automated Manufacturing System, Structure of Knowledge Based System for Group Technology (KBSCIT) Data Base, Knowledge Base, Clustering Algorithm.

TEXT BOOKS

1. Intelligent Manufacturing Systems, Andrew Kusiak, Prentice Hall, 1st Edition, 1990.
2. Artificial Neural Networks, Yagna Narayana, PHI, 1st Edition, 2006

REFERENCES:

1. Automation, Production Systems and CIM, Mikell P. Groover, PHI, 2nd Indian Reprint, 2007.
2. Neural networks: A comprehensive foundation, Simon Haykin, PHI, 2nd Edition, 2005.
3. Artificial neural networks, B. Vegnanarayana, PHI Learning Pvt. Ltd., 1st Edition, 2006.
4. Neural networks in Computer intelligence, Li Min Fu, TMH, 1st Edition, 2003.
5. Neural Networks: A Comprehensive Foundation, James A. Freeman and David M. Skapura, Pearson education, 2nd Edition, 2004.
6. Introduction to Artificial Neural Systems, Jacek M. Zurada, JAICO Publishing House, Indian Edition, 2006.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, II Semester

SMART MANUFACTURING

(Professional Elective – III)

L	T	P	C
3	0	0	3

Pre-requisites: Computer Networks, Fundamentals of Mechatronics

Course Objectives:

1. To understand the basics of Industry 4.0
2. To understand the Business model and impact of IIoT
3. To understand the concepts of virtual reality, lean manufacturing
4. To gain knowledge of various sensors and actuators.
5. To understand various data transmission technologies.

Course Outcomes: After completion of the course, the student will be able to

1. Explain Smart Business Perspective, Cybersecurity, and Impacts of Industry 4.0.
2. Understand the basics of the Industrial Internet of Things.
3. Understand various key technologies.
4. Implement various sensors and actuators.
5. Understand different industrial transmission technologies and IOT applications in real life

UNIT – I: Industry 4.0 Basics

Industrial Revolution: Phases, Evolution of Industry 4.0, Environmental Impacts of Industrial Revolution, Applications, Design Requirements, Drivers of Industry 4.0, Sustainability Assessment of Industries, Smart Business Perspective, Cyber Security, Impacts of Industry 4.0.

UNIT – II: Industrial Internet of Things and Digital Enterprise Architecture

Industrial Internet of Things, Basics: IIoT and Industry 4.0, IIC, Industrial Internet Systems, Design of Industrial Internet Systems, Impact of Industrial Internet, Benefits of Industrial Internet, Industrial Sensing, Industrial Processes, Features of IIoT for Industrial Processes, Industrial Plant, The Future Architecture, Digital Enterprise.

Business Models and Reference Architecture of IIoT: Definition of a Business Model, Business Models of IIoT, Industrial Internet Reference Architecture.

UNIT –III: Enabling Technologies for Smart Manufacturing and IIoT

Key Technologies: Off-site Technologies, Cloud Computing, Fog Computing. On-site Technologies, Augmented Reality, Virtual Reality, Smart Factories, Lean Manufacturing System, Big Data and Advanced Analytics.

UNIT –IV: Sensors and Actuators for Intelligent Systems

Sensors: Various Sensor Types and Their Underlying Working Principles, Characteristics of Sensors, Resolution, Calibration, Accuracy, and Others, Sensor Categories, Thermal, Mechanical, Electrical, Optical, and Acoustic Sensors.

Actuators: Thermal, Hydraulic, Pneumatic, and Electromechanical Actuators.

UNIT – V: Industrial Communication Systems and IIoT Applications

Industrial Data Transmission and Acquisition: Architecture of Various Data Transmission Technologies Like Foundation Fieldbus, Profibus, Highway Addressable Remote Transducer (HART), Interbus, Bitbus, Digital STROM, Controller Area Network, and Other Recent and Upcoming Technologies. Distributed Control System, SCADA, and P L C System. IIoT Applications: IoT Applications on Industrial Automation, Factories and Assembly Line, Plant Security and Safety, Transportation, Agriculture, Healthcare, Home Automation, Oil, Chemical and Pharmaceutical Industry, and Others.

TEXT BOOKS:

1. Introduction to Industrial Internet of Things and Industry 4.0, Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press, 1st Edition, 2021.
2. Internet of Things: A Hands-on Approach, Vijay Madisetti and Arshdeep Bahga, University Press, 1st Edition, 2015.
3. Introduction to Internet of Things: A Practical Approach, S.R.N. Reddy, Rachit Thukral, Manasi Mishra, ETI Labs, 1st Edition, 2016.

REFERENCE BOOKS:

1. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, Apress, 1st Edition, 2016.
2. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer, 1st Edition, 2011.
3. Smart Manufacturing: Concepts and Methods, Anthony Tarantino, CRC Press, 1st Edition, 2022.
4. Enabling the Internet of Things: From Integrated Circuits to Integrated Systems, Massimo Alioto, Springer, 1st Edition, 2017.
5. Industrial Internet of Things: Cybermanufacturing Systems, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Springer, 1st Edition, 2017.
6. Cyber-Physical Systems: Foundations, Principles and Applications, Houbing Song, Danda B. Rawat, Sabina Jeschke, Christian Brecher, Morgan Kaufmann, 1st Edition, 2016.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, II Semester

OPTIMIZATION TECHNIQUES AND APPLICATIONS

(Professional Elective – III)

L	T	P	C
3	0	0	3

Pre-requisites: Operations Research

Course Objectives:

1. To introduce the fundamentals of optimization and its role in engineering and decision-making.
2. To develop the ability to formulate optimization problems for real-world applications.
3. To familiarize students with classical, numerical, and modern optimization techniques.
4. To enable analysis and comparison of various optimization algorithms for efficiency and accuracy.
5. To apply optimization methods to solve practical problems in manufacturing, design, and management.

Course Outcomes: At the end of the course, the student will be able to

1. Apply suitable optimization techniques to solve single-variable and multivariable problems.
2. Perform sensitivity analysis for parameter changes in Linear Programming Problems.
3. Solve integer and stochastic programming problems using appropriate algorithms.
4. Formulate and solve Goal Programming models for multi-objective optimization.
5. Apply metaheuristic methods such as Genetic Algorithm, Simulated Annealing, and Particle Swarm Optimization to real-world problems.

UNIT-I: Linear Programming

Formulation, Simplex Method and Artificial Variable Optimization Techniques: Big M and Two-Phase Methods. Sensitivity Analysis: Changes in the Objective Coefficients, Constants and Coefficients of the Constraints. Addition of Variables, Constraints. Simulation, Introduction, Types, Steps, Applications. Inventory and Queuing: Advantages and Disadvantages.

UNIT-II: Integer and Stochastic Programming Techniques

Integer Programming: Introduction, Formulation, Geometry, Cutting Plane Algorithm, Zero or One Algorithm, Branch and Bound Method.

Stochastic Programming: Basic Concepts of Probability Theory, Random Variables, Distributions - Mean, Variance, Correlation, Co-Variance, Joint Probability Distribution. Stochastic Linear Programming: Chance Constrained Algorithm.

UNIT-III: Single Variable Non-Linear Unconstrained Optimization

Elimination Methods: Uni-Model Function, Its Importance. Fibonacci Method and Golden Section Method. Interpolation Methods: Quadratic and Cubic Interpolation Methods.

UNIT-IV: Multi variable non-linear unconstrained optimization

Direct Search Methods, Univariant Method, Pattern Search Methods, Powell's, Hook Jeeves, Rosenbrock Search Methods. Gradient Methods: Gradient Of Function and its Importance, Steepest Descent Method, Conjugate Direction Methods: Fletcher- Reeves Method Variable Metric Method.

UNIT-V: Geometric Programming and Modern Optimization Methods

Geometric Programming: Posynomials, Arithmetic, Geometric Inequality, Unconstrained G.P, Constrained G.P (≤ Type Only).

Non-Traditional Optimization Algorithms: Genetics Algorithm, Working Principles, Similarities and Differences Between Genetic Algorithm and Traditional Methods. Simulated Annealing, Working Principle, Simple Problems. Introduction to Particle Swarm Optimization. (PSO).

TEXTBOOKS:

1. Engineering Optimization: Theory and Practice, S. S. Rao, New Age International Pvt. Ltd Publishers, 3rd Edition, 2013.
2. Optimization for Engineering Design: Algorithms and Examples, Kalyanmoy Deb, PHI, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Operations Research: Theory and Applications, S. D. Sharma, Kedar Nath Ram Nath Publisher, 4th Edition, 2022.
2. Operations Research: An Introduction, H. A. Taha, Pearson Publisher, 10th Edition, 2019.
3. Optimization in operations research, R. L Rardin, Pearson Imprint, 3rd Edition, 2016.
4. Optimization Techniques, Chakraverty and P. R. Chandraputla, Pearson Asia, 1st Edition, 2011.
5. Optimization: Theory and Practice, Mohan C. Joshi and Kannan M. Moudgalya, Narosa Publishing House, 1st Edition, 2004.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, II Semester

MECHATRONICS

(Professional Elective – IV)

L	T	P	C
3	0	0	3

Prerequisites: Mechanical Engineering Fundamentals, Basic Electrical and Electronics Engineering

Course Objectives:

1. To understand the mechatronics systems.
2. To provide an in-depth understanding of components of knowledge-based systems.
3. To provide an understanding of artificial intelligence.
4. To design and develop automated process planning.
5. To develop group technology for intelligent manufacturing systems.

Course outcomes: After completing this course, the student will be able to

1. Understand and describe different mechatronics systems.
2. Explain the principle of operation of various solid-state devices.
3. Describe the working of hydraulic and pneumatic actuating systems and use them appropriately.
4. Use program logic controls effectively.
5. Design mechatronic systems.

UNIT – I: Mechatronic Systems and Design Process

Mechatronics Systems, Elements, Levels of Mechatronics Systems, Mechatronics Design Process, System, Measurement Systems, Control Systems, Microprocessor-Based Controllers, Advantages and Disadvantages of Mechatronics Systems. Sensors and Transducers, Types, Displacement, Position, Proximity, Velocity, Motion, Force, Acceleration, Torque, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, and Light Sensors.

UNIT – II: Sensors, Transducers and Signal Conditioning

Solid state electronic devices, PN junction diode, BJT, FET, DIA, and TRIAC. Analog signal conditioning, amplifiers, and filtering. Introduction to MEMS and typical applications.

UNIT – III: Actuators and Drive Systems

Design Consideration, Hydraulic and Pneumatic Actuating Systems, Fluid Systems, Hydraulic and Pneumatic Systems, Components, Control Valves, Electro Pneumatic, Hydro Pneumatic, Electro Hydraulic Servo Systems: Mechanical Actuating Systems and Electrical Actuating Systems.

UNIT – IV: Microprocessors, Microcontrollers and Interfacing

Digital Electronics and Systems, Digital Logic Control, Micro Processors and Micro Controllers, Programming, Process Controllers, Programmable Logic Controllers, PLCs Versus Computers, Application of PLCs for Control.

UNIT – V: System Modeling and Simulation

System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems and future trends.

TEXT BOOKS:

1. Mechatronics Integrated Mechanical Electronics Systems, K P Ramachandran and GK Vijaya Raghavan, Wiley India Edition, 2008.
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, W Bolton, Pearson Education Press, 3rd Edition, 2005.

REFERENCES BOOKS:

1. Mechatronics Source Book, Newton C. Braga, Thomson Publications, Chennai, 1st Edition, 2002.
2. Mechatronics System Design, Devdas Shetty, Richard A. Kolk, Thomson Learning, 2nd Edition, 2005.
3. Mechatronics, M.D. Singh, J.G. Joshi, Prentice-Hall of India (PHI), 1st Edition, 2006.
4. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering, W. Bolton, Pearson Education, 4th Edition, 2012.
5. Mechatronics – Principles and Applications, Godfrey C. Onwubolu, Elsevier, Indian Print, 1st Edition, 2006.
6. Introduction to Mechatronics and Measurement Systems, David G. Alciatore and Michael B. Histand, McGraw-Hill Education, 6th Edition, 2023.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, II Semester

MEMS: DESIGN AND MANUFACTURING

(Professional Elective – IV)

L	T	P	C
3	0	0	3

Prerequisites: Electronic Circuits, Basic knowledge in material science.

Course Objectives:

1. To introduce the fundamentals, design principles, and applications of MEMS devices.
2. To study microfabrication and micromachining processes used in MEMS manufacturing.
3. To understand the operation of microsensors, microactuators, and microstructures.
4. To explore materials, modeling, and simulation techniques for MEMS design.
5. To examine packaging, testing, and reliability aspects of MEMS products.

Course Outcomes: At the end of the course, the student will be able to

1. Explain the structure, working principles, and applications of MEMS devices.
2. Select suitable materials and fabrication techniques for MEMS manufacturing.
3. Analyze the design and performance of microsensors and microactuators.
4. Use modeling and simulation tools for MEMS product development.
5. Evaluate packaging, reliability, and industrial applications of MEMS.

UNIT-I: MEMS and Microsystems

MEMS and Microsystems, Evolution of Micro Fabrication, Microsystems and Microelectronics, Microsystems and Miniaturization, Applications of MEMS in Industries, Micro Sensors, Micro Actuation, MEMS with Micro Actuators, Micro Accelerometers, Micro Fluidics.

UNIT-II: Engineering Science for Microsystems Design

Atomic Structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

UNIT-III: Engineering Mechanics for Microsystems Design

Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, and Overview of Finite Element Stress Analysis.

UNIT-IV: Thermo Fluid Engineering and Microsystems Design

Overview of Basics of Fluid Mechanics in Macro and Micro scales, Basic equations in Continuum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and solids in Sub Micrometer Scale, Design Considerations, Process Design Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT-V: Materials for MEMS and Microsystems

Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

TEXT BOOKS:

1. MEMS and Microsystems: Design and Manufacturing, Tia-Ran Hsu, Tata McGraw-Hill, 1st Edition, 2002.
2. Foundations of MEMS, Chang Liu, Pearson Education, 2nd Edition, 2012.

REFERENCE BOOKS:

1. An Introduction to Microelectromechanical Systems Engineering, Nadim Maluf, Artech House, 1st Edition, 2000.
2. Micro Robots and Micromechanical Systems, W.S.N. Trimmer, Sensors and Actuators, Volume 19, 1989.
3. Applied Partial Differential Equations, D.W. Trim, PWS-Kent Publishing, Boston, 1st Edition, 1990.
4. MEMS: Introduction and Fundamentals, Mohamed Gad-el-Hak, CRC Press, 3rd Edition, 2022.
5. Microelectromechanical Systems: Design and Analysis, Tai-Ran Hsu, John Wiley and Sons, 2nd Edition, 2023.
6. Design and Development Methodologies for MEMS and Microfluidic Devices, Paul Kirby and Philip LeDuc, Elsevier, 1st Edition, 2022.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
FUZZY LOGIC AND NEURAL NETWORKS
(Professional Elective – IV)

L	T	P	C
3	0	0	3

Prerequisites: Probability and Statistics, Basics of Artificial Intelligence

Course Objective:

1. To introduce the fundamentals of fuzzy logic and fuzzy set theory.
2. To study the design and application of fuzzy inference systems.
3. To understand the structure, learning algorithms, and applications of neural networks.
4. To explore hybrid systems integrating fuzzy logic and neural networks.
5. To apply fuzzy and neural computing techniques to real-world engineering problems.

Course Outcomes: At the end of the course, the student will be able to:

1. Explain fuzzy set theory, membership functions, and fuzzy rules.
2. Design fuzzy inference systems for decision-making and control applications.
3. Apply perceptron, backpropagation, and other learning algorithms in neural networks.
4. Develop hybrid neuro-fuzzy systems for complex problem solving.
5. Implement fuzzy logic and neural network models in engineering applications.

UNIT- I: Fuzzy Set Theory and Logic Control

Basic Concepts of Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relation Equations, Fuzzy Logic Control, Fuzzification, Defuzzification, Knowledge Base, Decision Making Logic, Membership Functions, Rule Base.

UNIT- II: Adaptive Fuzzy Systems

Performance Index, Modification of Rule Base, Modification of Membership Functions, Simultaneous Modification of Rule Base and Membership Functions, Genetic Algorithms, Adaptive Fuzzy System, Neuro Fuzzy Systems.

UNIT- III: Artificial Neural Networks

Introduction, History of Neural Networks, Multilayer Perceptions, Back Propagation Algorithm and its Variants, Different Types of Learning, Examples.

UNIT- IV: Mapping and Recurrent Networks

Counter Propagation, Self Organization Map, Congnitron and Neocognitron, Hopfield Net, Kohonnen Nets, Grossberg Nets, Art-I, Art-II, Reinforcement Learning.

UNIT- V: Case Studies

Application of Fuzzy Logic and Neural Networks to Measurement, Control, Adaptive Neural Controllers, Signal Processing and Image Processing.

TEXT BOOK:

1. C++, Neural Networks and Fuzzy Logic, Vallum B.R. and Hayagriva V.R., BPB Publications, New Delhi, 1st Edition, 1996.
2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Wiley, 5th Edition, 2023.

REFERENCE BOOKS:

1. Fuzzy Logic and Neural Networks, Chennakesava R. Alavala, New Age International, 1st Edition, 2008.
2. Neural Networks for Control, W. Thomas Millon, Richard S. Sutton, Paul J. Werbos, MIT Press, 1st Edition, 1992.
3. Fuzzy Sets, Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice-Hall of India Pvt. Ltd., New Delhi, 1st Edition, 1995.
4. Neural Networks and Fuzzy Systems, Bart Kosko, Prentice-Hall of India Pvt. Ltd., New Delhi, 1st Edition, 1994.
5. Introduction to Fuzzy Control, Dimiter Driankov, Hans Hellendoorn, Michael Reinfrank, Narosa Publishing House, New Delhi, 1st Edition, 1996.
6. Introduction to Artificial Neural Systems, Jacek M. Zurada, Jaico Publishing House, New Delhi, Indian Edition, 1994.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
SIMULATION OF MANUFACTURING SYSTEMS LAB

L	T	P	C
0	0	4	2

Prerequisites: Manufacturing Systems, Simulation Modelling

Course Objectives:

1. To provide hands-on experience in simulating manufacturing processes and systems.
2. To develop skills in using simulation software for production planning and control.
3. To analyze manufacturing system performance using simulation models.
4. To apply simulation for resource optimization and process improvement.
5. To prepare simulation-based reports for decision-making in manufacturing.

Course Outcomes: Upon completion of the lab, students will be able to

1. Develop simulation models for different manufacturing processes.
2. Use simulation tools to analyze production system performance.
3. Apply statistical analysis for interpreting simulation results.
4. Optimize manufacturing resources and workflows through simulation.
5. Document and present simulation studies effectively.

List of Experiments

A. Manufacturing and Simulation

1. Study and Application of AutoMOD Software to Manufacturing Problems.
2. Study and Application of PROMODEL Software to Manufacturing Problems.
3. Study and Application of SLAM-II Software to Manufacturing Problems.
4. Study and Application of CAFIMS Software to Manufacturing Problems.
5. Study and Application of Flexsim Software to Manufacturing Problems.

Write Subroutines in C Language and Interlinking with Simulation Packages for the following Experiments.

1. AGV Planning Simulation.
2. ASRS Simulation and Performance Evaluation.
3. Integrated Simulation of Machines, AGVs, and AS/RS.
4. JIT System Simulation.
5. Kanban Flow Simulation.
6. Material Handling System Simulation.
7. MRP Problem Simulation.
8. Shop Floor Scheduling Simulation.

B. Precision Engineering (Using Suitable Software)

1. Simulation of Hydraulic and Pneumatic Circuits.
2. Simulation of Closed Loop Control Systems.
3. Study of Operation of Tool and Cutter Grinder, Twist Drill Grinder, Centerless Grinder.
4. Determination of Cutting Forces in Turning.
5. Experiments on AJM and Study of USM, EDM, Laser Machining, and Plasma Spraying.
6. Inspection of Parts Using Tool Makers Microscope.
7. Surface Roughness Measurement and Form Testing.
8. Study of Microcontrollers and Programming for CNC Machine Tools and Controllers.
9. Studies on PLC Programming.
10. Study and Programming of Robots.
11. Condition Monitoring in Machining Process Using Acoustic Emission.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
COMPUTER AIDED MANUFACTURING LAB

L	T	P	C
0	0	4	2

Prerequisites: Computer Aided Manufacturing, CNC Programming

Course Objectives:

1. To provide practical training in CNC programming and machine operation.
2. To develop skills in generating tool paths using CAM software.
3. To integrate CAD models into CAM systems for manufacturing.
4. To perform machining simulations for process verification.
5. To prepare detailed manufacturing documentation for CNC operations.

Course Outcomes:

1. Write and execute CNC programs for milling and turning operations.
2. Use CAM software to generate and optimize tool paths.
3. Simulate machining operations to verify accuracy and safety.
4. Integrate CAD geometry into CAM workflows.
5. Produce manufacturing documentation including setup sheets and process plans.

List of Experiments:

A. CNC Turning:

1. External Turning Operation: Turning a mild steel cylindrical job to specified diameter and length.
2. Facing and Chamfering: Facing both ends of a workpiece and adding chamfers as per drawing.
3. Grooving and Parting Off: Machining a circumferential groove at a given position, followed by parting-off.
4. Taper Turning: Producing a specified taper using CNC programming commands.

B. CNC Milling:

1. Face Milling: Milling the top surface of an aluminium block to achieve a uniform finish.
2. Slot Milling: Producing a straight slot of given width and depth on a rectangular workpiece.
3. Pocket Milling: Machining a rectangular pocket with defined dimensions and depth.
4. Profile Milling: Machining an external contour as per the given profile drawing.

C. Robot Programming:

1. Lead-Through Programming Using Teach Pendant**:** Record and execute a pick-and-place operation involving three positions with defined approach and departure points.
2. Forward and Inverse Kinematics with Trajectory Planning**:** Program the robot to move its end-effector through a set of predefined Cartesian coordinates, compute joint angles (inverse kinematics), and verify path accuracy through smooth trajectory generation.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., II Year, I Semester
DESIGN FOR MANUFACTURING AND ASSEMBLY
(Professional Elective – V)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes, Engineering Materials

Course Objectives:

1. Introduce the principles and constraints of manufacturability that influence product design.
2. Familiarize students with Design for Manufacturability (DFM) methodology and its application across various manufacturing processes.
3. Enable students to identify infeasible or impractical designs early in the product development cycle.
4. Guide students to select appropriate materials and processes based on functionality and manufacturability.
5. Equip students with tools to improve assembly efficiency through manual and automated design considerations.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand and evaluate quality and cost aspects of product design for manufacture and assembly.
2. Apply Boothroyd's systematic DFA/DFM methods to optimize design and improve manufacturability.
3. Integrate DFM principles in casting, machining, forming, welding, and plastic component design.
4. Analyze and identify key design variables to align product development with customer and process specifications.
5. Apply automation and manual assembly techniques to enhance production efficiency and reliability.

UNIT - I: Design and Material Selection

Introduction, Design Philosophy, Steps in Design Process, General Design Rules for Manufacturability, Basic Principles of Designing for Economical Production, Creativity in Design. Selection of Materials for Design, Developments in Material Technology, Criteria for Material Selection, Material Selection Interrelationship with Process Selection, Process Selection Charts.

UNIT - II: Machining and Casting Design

Machining Process: Overview of Various Machining Processes, General Design Rules for Machining, Dimensional Tolerance and Surface Roughness, Design for Machining Ease, Redesigning of Components for Machining Ease with Suitable Examples, General Design Recommendations for Machined Parts. Metal Casting: Appraisal of Various Casting Processes, Selection of Casting Process, General Design Considerations for Casting, Casting Tolerances, Use of Solidification Simulation in Casting Design, Product Design Rules for Sand Casting.

UNIT - III: Forming, Joining and Plastics

Metal Joining: Appraisal of Various Welding Processes, Factors in Design of Weldments, General Design Guidelines, Pre- and Post-Treatment of Welds, Effects of Thermal Stresses in

Weld Joints, Design of Brazed Joints.
Forging: Design Factors for Forging, Closed Die Forging Design, Parting Lines of Dies, Drop Forging Die Design, General Design Recommendations.
Extrusion and Sheet Metal Work: Design Guidelines for Extruded Sections, Design Principles for Punching, Blanking, Bending, Deep Drawing, Keeler-Goodman Forming Line Diagram, Component Design for Blanking.
Plastics: Viscoelastic and Creep Behaviour in Plastics, Design Guidelines for Plastic Components, Design Considerations for Injection Moulding.

UNIT-IV: Automated Assembly Design

Assembly Advantages: Development of the Assembly Process, Choice of Assembly Method, Assembly Advantages, and Social Effects of Automation.
Automatic Assembly Transfer Systems: Continuous Transfer, Intermittent Transfer, Indexing Mechanisms, and Operator-Paced Free-Transfer Machine.

UNIT-V: Design of Manual Assembly

Design for Assembly: Fits in the Design Process, General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Classification System for Manual Handling, Classification System for Manual Insertion and Fastening, Effect of Part Symmetry on Handling Time, Effect of Part Thickness and Size on Handling Time, Effect of Weight on Handling Time, Parts Requiring Two Hands for Manipulation, Effects of Combinations of Factors, Effect of Symmetry, Effect of Chamfer Design on Insertion Operations, Estimation of Insertion Time.

TEXT BOOKS:

1. Assembly Automation and Product Design, Geoffrey Boothroyd, Marcel Dekker Inc., New York, 1st Edition, 1992.
2. Engineering Design: A Materials and Processing Approach, George E. Dieter, McGraw-Hill International, 2nd Edition, 2000.
3. Handbook of Product Design, Geoffrey Boothroyd, Marcel Dekker Inc., New York, 1st Edition, 1990.

REFERENCES:

1. Product Design for Manufacturing and Assembly, Geoffrey Boothroyd, Peter Dewhurst, Winston Anthony Knight, CRC Press, 3rd Edition, 2010.
2. Design for Manufacturability Handbook, James G. Bralla, McGraw-Hill, 2nd Edition, 1999.
3. Materials and Design: The Art and Science of Material Selection in Product Design, Michael F. Ashby and Kara Johnson, Butterworth-Heinemann, 3rd Edition, 2013.
4. Manufacturing Processes for Design Professionals, Rob Thompson, Thames and Hudson, 1st Edition, 2007.
5. Design and Manufacturing of Plastics Products, Nabil Bashir, Wiley-Scrivener, 1st Edition, 2020.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., II Year, I Semester

COMPOSITE MATERIALS

(Professional Elective – V)

L	T	P	C
3	0	0	3

Prerequisite: Mechanics of Materials, Materials Science

Course objectives:

1. To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing teaching
2. To predict the elastic properties of both long and short fibers
3. Understand the stress-strain relations.
4. To know the macro mechanical analysis of lamina and laminates.
5. Establish the failure criteria for laminated structures.

Course Outcomes: At the end of the course, the students will be able to

1. Understand and differentiate various types of composites.
2. Understand different types of reinforcements and describe various manufacturing methods of composites
3. Analyze problems on macro and micro mechanical behavior of the lamina
4. Analyze problems on the macro mechanical behavior of the laminate
5. Use the ideas developed in the analysis of composites towards using composites in aerospace design.

UNIT - I: Composite Materials and Applications

Introduction, Classification of Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and Nature Made Composites, and Applications.

UNIT -II: Mechanical Behavior of Composites

Reinforcements: Fibers, Glass, Silica, Kevlar, Carbon, Boron, Silicon Carbide, and Boron Carbide Fibers, Particulate Composites, Polymer Composites, Thermoplastics, Thermosets, Metal Matrix, and Ceramic Composites.

Manufacturing Methods: Autoclave, Tape Production, Moulding Methods, Filament Winding, Man Layup, Pultrusion, and RTM.

UNIT -III: Macro Mechanical Analysis of Lamina

Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT -IV: Laminate Mechanics and Hygro-thermal Effects

Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygrothermal Effects in a Laminate, Warpage of Laminates.

UNIT -V: Laminated Composite Design and Failure

Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues, MMC and PMC.

TEXT BOOKS:

1. Mechanics of Composite Materials, R.M. Jones, McGraw-Hill Company, New York, 1st Edition, 1975.
2. Engineering Mechanics of Composite Materials, Isaac M. Daniel, Oxford University Press, 1st Edition, 1994.

REFERENCE BOOKS:

1. Analysis and Performance of Fiber Composites, B.D. Agarwal and L.J. Broutman, Wiley-Interscience, New York, 1st Edition, 1980.
2. Introduction to Composite Materials Design, Ever J. Barbero, CRC Press, 4th Edition, 2023.
3. Engineering Mechanics of Composite Materials, Isaac M. Daniel and Ori Ishai, Oxford University Press, 3rd Edition, 2023.
4. Composite Materials: Processing, Applications, and Characterization, M. Balasubramanian, Springer, 2nd Edition, 2022.
5. Analysis and Performance of Fiber Composites, Bhagwan D. Agarwal and Lawrence J. Broutman and K. Chandrashekhara, Wiley, 4th Edition, 2023.
6. Structural Analysis of Composite Materials, Mark E. Tuttle, CRC Press, 3rd Edition, 2022.
7. Mechanics of Composite Materials, Autar K. Kaw, CRC Press, 2nd Edition, 2006

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., II Year, I Semester
ARTIFICIAL INTELLIGENCE IN MANUFACTURING
(Professional Elective – V)

L	T	P	C
3	0	0	3

Prerequisite: Production Systems, Fundamentals of Artificial Intelligence

Course Objectives:

1. To introduce the fundamentals of artificial intelligence and its relevance in manufacturing.
2. To study AI techniques applicable to production planning, process control, and quality management.
3. To explore machine learning algorithms for predictive maintenance and process optimization.
4. To apply AI for real-time monitoring, robotics, and automation in manufacturing environments.
5. To familiarize students with case studies and industrial applications of AI in manufacturing.

Course Outcomes: After completion of this course the student will be able to

1. Understand the basic concepts of AI and its applications in manufacturing systems.
2. Apply machine learning techniques for manufacturing process optimization.
3. Analyze manufacturing data for predictive analytics and decision-making.
4. Implement AI-based solutions in robotics, automation, and process control.
5. Evaluate AI-driven manufacturing systems for productivity and quality improvement.

UNIT - I: AI and Search Methods

Definition, History, Present State of Artificial Intelligence (AI), Phases of AI, Approaches to AI - Hard or Strong AI, Soft or Weak AI, Applied AI, Cognitive AI, and Applications Domains Focused on Manufacturing-Role of AI in Industrial Revolution 4.0, Components, Advantages, Challenges. Problem Solving Methods- 1. Uninformed Search Includes Depth First Search (DFS), Breadth First Search (BFS), Uniform Cost Search (UCS), Depth Limited Search, Iterative Deepening Depth First Search (IDDFS), And Bidirectional Search. 2. Informed Search (Heuristic Search) Includes Greedy Best First Search, A* Search, Memory Bounded Heuristic Search, Learning to Search Better, Simple Problems

UNIT - II: Neural Networks

Introduction to Perceptron and Neural Networks, Activation and Loss Functions, Single Neuron of Human and Human Brain Modelling, ANN Architecture-Input Layer, Hidden Layer and Output Layer, Types of Neural Networks- Single Layer Feed-Forward Network, Multilayer Feed-Forward Network, Multi-Layer Perceptron (MLP), Recurrent Networks or Feedback ANN, Characteristics of Neural Networks, Simple Problems on Back Propagation Algorithms to Minimize the Error.

UNIT - III: Computer Vision and CNNs

Introduction to Convolutional Neural Networks (CNNS), What is CNN, Common Uses for CNN, CNN's Basic Architecture- LeNet, Alexnet, Vggnet, Google net, Resnet, Introduction to Images, Representation, Image Extraction, Segmentation, Analysis, Simple Demonstration on Image Processing Using ANN - Face Detection, Fingerprint Recognition, etc.

UNIT - IV: Supervised and Unsupervised Learning

Unsupervised Learning, Definition, Basic Concepts, Applications, K-Means Clustering, Hierarchical Clustering, Dimension Reduction-PCA, Simple Examples.

Supervised Learning: Definition, Basic Concepts, Applications, Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, K-NN Classification, Support Vector Machine, Simple Examples.

UNIT - V: Reinforcement and Ensemble Learning

Reinforcement Learning: Reinforcement Learning (RL) Framework, Component of RL Framework, Types of RL Systems. Q-Learning, Simple Examples. Ensemble Learning Techniques: Introduction on Ensemble Methods, Decision Trees, Bagging, Random Forests, Boosting, Simple Examples.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Prentice-Hall, 3rd Edition (2009)
2. Nature-Inspired Optimization in Advanced Manufacturing Processes and Systems, Ganesh M. Kakandikar and Dinesh G. Thakur, CRC Press, 1st Edition, 2021.

REFERENCES:

1. Artificial Intelligence, Ela Kumar, Wiley-India, 1st Edition, 2020.
2. Artificial Intelligence: Concepts and Applications, Lavika Goel, Wiley-India, 1st Edition, 2021.
3. Artificial Intelligence for Robotics and Industrial Applications, Abhishek Arora and Sanjeev Kumar, Wiley India, 1st Edition, 2023.
4. Machine Learning for Manufacturing, Davide Polonio and Paolo Rizzi, Springer, 1st Edition, 2022.
5. Deep Learning for Vision Systems, Mohamed Elgendy, Manning Publications, 1st Edition, 2021.
6. Hands-On Artificial Intelligence for Smart Manufacturing, Francesco Carlo Morabito, Springer, 1st Edition, 2023.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Basic English Grammar and Composition, Fundamentals of Technical Writing

Course objectives: Students will be able to:

1. To improve the quality and clarity of academic writing, specifically for research papers.
2. To provide students with the structure, style, and conventions of scholarly communication.
3. To help students understand how to write titles, abstracts, introductions, literature reviews, methods, results, and conclusions effectively.
4. To guide students in avoiding common grammatical, structural, and ethical mistakes in writing.
5. To build competence in reviewing and editing research manuscripts for publication.

Course Outcomes: After the successful completion of this course, students will be able to:

1. Write grammatically correct, well-structured, and coherent research papers.
2. Use appropriate academic language and tone for different parts of a research article.
3. Construct effective titles, abstracts, and concise conclusions.
4. Apply standard referencing styles and avoid plagiarism.
5. Critically revise and refine research drafts for clarity and publication readiness.

UNIT-I: Effective Writing and Sentence Structuring
Planning and Preparation, Word Order, breaking up Long Sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II: Academic Writing and Research Ethics
Clarifying Who Did What, highlighting your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction

UNIT-III: Research Paper Structure and Finalization
Review of the Literature, Methods, Results, Discussion, Conclusions, and Final Check.

UNIT-IV: Essential Academic Writing Skills for Research Papers
Key Skills are needed when writing a Title, Key Skills are needed when writing an Abstract, Key Skills are needed when writing an Introduction, and Skills are needed when writing a Review of the Literature.

UNIT-V: Advanced Research Writing Skills
Skills are needed when writing the Methods, Skills needed when writing the Results, Skills are needed when writing the Discussion, and Skills are needed when writing the Conclusions.

UNIT-VI: Perfecting Your Research Paper

Useful Phrases: How to ensure the Paper is as Good as it could be for the First Time Submission.

TEXT BOOKS:

1. Writing for Science, Robert Goldbort, Yale University Press, 1st Edition, 2006.
2. How to Write and Publish a Scientific Paper, Robert A. Day & Barbara Gastel, 6th Edition (Cambridge University Press), 2006.

REFERENCE BOOKS

1. Handbook of Writing for the Mathematical Sciences, Nicholas J. Higham, SIAM, 2nd Edition, 1998.
2. English for Writing Research Papers, Adrian Wallwork, Springer, 1st Edition, 2011.
3. How to Write and Publish a Scientific Paper, Barbara Gastel, Robert A. Day, Cambridge University Press, 8th Edition, 2016
4. The Elements of Style, William Strunk Jr., E.B. White, Pearson Education, 4th Edition, 2000
5. Scientific Writing and Communication: Papers, Proposals, and Presentations, Angelika H. Hofmann, Oxford University Press, 3rd Edition, 2016
6. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded, Joshua Schimel, Oxford University Press, 1st Edition, 2012

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
DISASTER MANAGEMENT
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Environmental Science, Basic Geography, or Earth Science

Course Objectives: Students will be able to

1. To introduce the concepts, phases, and classifications of disasters and disaster management.
2. To develop an understanding of disaster risk reduction and mitigation strategies.
3. To impart knowledge on institutional frameworks, legal aspects, and community-based approaches.
4. To build the ability to assess risks and prepare emergency management plans.
5. To create awareness about post-disaster recovery, rehabilitation, and resilience planning.

Course Outcomes: After the successful completion of this course, students will be able to

1. Identify different types of natural and man-made disasters and their causes.
2. Analyze risk factors and develop suitable mitigation and preparedness strategies.
3. Understand the role of government agencies, NGOs, and international bodies in disaster management.
4. Apply principles of emergency response planning and coordination.
5. Contribute to post-disaster rehabilitation and sustainable development planning.

UNIT-I: Disaster

Definition, Factors and Significance, Difference between Hazard and Disaster, Natural and Manmade Disasters, Difference between Nature Types and Magnitude.

UNIT-II: Repercussions of Disasters and Hazards

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanoes, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches. Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III: Disaster-Prone Areas in India

Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches, Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami, Post Disaster Diseases and Epidemics

UNIT-IV: Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard, Evaluation of Risk, Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V: Risk Assessment Disaster Risk

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation, Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

UNIT-VI: Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS:

1. Disaster Management in India: Perspectives, Issues and Strategies, R. Nishith & A. K. Singh, New Royal Book Company, 1st Edition, 2007
2. Disaster Mitigation: Experiences and Reflections, Pardeep Sahni et al. (Eds.), Prentice Hall India, 1st Edition, 2001

REFERENCE BOOKS:

1. Disaster Administration and Management: Text and Case Studies, S. L. Goel, Deep & Deep Publications, 1st Edition, 2007.
2. Introduction to International Disaster Management, Damon P. Coppola, Butterworth-Heinemann, 3rd Edition, 2015.
3. Disaster Management and Preparedness, Thomas D. Schneid, Larry Collins, CRC Press, 1st Edition, 2001.
4. Disaster Science and Management, Tushar Bhattacharya, McGraw Hill Education, 1st Edition, 2013.
5. Natural Disasters, Patrick L. Abbott, McGraw Hill Education, 9th Edition, 2016.
6. Environmental Hazards: Assessing Risk and Reducing Disaster, Keith Smith, Routledge, 6th Edition, 2013.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Basic understanding of Indian heritage and classical languages

Course Objectives:

1. To expose students to Sanskrit as a classical language of knowledge and science.
2. To introduce technical terms and concepts embedded in ancient Sanskrit texts.
3. To enable understanding of foundational texts related to mathematics, engineering, and philosophy.
4. To build linguistic skills for reading and interpreting original Sanskrit sources.
5. To appreciate the relevance of Sanskrit in the context of modern scientific discourse.

Course Outcomes: Students will be able to

1. Understand the structure and grammar of Sanskrit relevant to technical usage.
2. Recognize and interpret key technical terms and concepts from ancient Sanskrit literature.
3. Translate and explain Sanskrit verses that relate to scientific and engineering disciplines.
4. Develop an interdisciplinary perspective connecting ancient wisdom with contemporary science.
5. Appreciate the contribution of Sanskrit to Indian scientific, philosophical, and cultural heritage.

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past / Present / Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of Roots,

UNIT-IV:
Technical Information about Sanskrit Literature

UNIT-V:
Technical Concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS:

1. Abhyaspustakam, Dr. H. R. Vishwasa, Samskrita Bharati Publication, New Delhi, 1st Edition, 2012.
2. Teach Yourself Sanskrit: Prathama Diksha, edited by Vempati Kutumbashastri, Rashtriya Sanskrit Sansthanam, New Delhi, 1st Edition, 2002.

REFERENCE BOOKS:

1. Technical Literature in Sanskrit, S. Balachandra Rao, Rashtriya Sanskrit Vidyapeetha, 1st Edition, 2005.
2. Sanskrit and Science, Prabhakar Apte, Central Institute of Indian Languages, 1st Edition, 2003.
3. Scientific Heritage of India in Sanskrit, R. Ganapathi, Bharatiya Vidya Bhavan, 1st Edition, 1990.
4. Sanskrit and Artificial Intelligence, Rick Briggs, AI Magazine (Journal Paper), 1st Edition, 1985.
5. Essentials of Sanskrit Language for Engineering Students, M. Sampath Kumar, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, 1st Edition, 2010.
6. Vyavaharika Samskritam (Functional Sanskrit), R.S. Vadhyar, R.S. Vadhyar & Sons, 3rd Edition, 2008.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, I Semester
VALUE EDUCATION
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Basic Understanding of Ethics and Social Responsibility

Course Objectives: Students will be able to

1. To help students understand the importance of values in personal and professional life.
2. To promote ethical behavior and decision-making based on human values.
3. To develop a sense of responsibility, empathy, and integrity.
4. To cultivate respect for diversity, equality, and sustainable living.
5. To encourage self-reflection and a commitment to lifelong value-based learning.

Course Outcomes: Students will be able to

1. Recognize and apply core human values such as honesty, compassion, and respect.
2. Analyze ethical dilemmas and make morally sound decisions.
3. Demonstrate socially responsible behavior in both personal and professional contexts.
4. Promote harmony in relationships, society, and the environment.
5. Engage in continuous personal development guided by ethical principles.

UNIT-I: Values and Ethics

Values and Self-Development, Social Values and Individual Attitudes, Work Ethics, Indian Vision of Humanism, Moral and Non- Moral Valuation, Standards and Principles, Value Judgements.

UNIT-II: Core Personal Values

Importance of Cultivation of Values, Sense of Duty, Devotion, Self-Reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of Faith, National Unity, Patriotism, Love for Nature, Discipline.

UNIT-III: Personality Traits

Personality and Behavior Development, Soul and Scientific Attitude, Positive Thinking, Integrity and Discipline, Punctuality, Love and Kindness.

UNIT-IV: Virtuous Living

Avoid Fault Thinking, Free from Anger, Dignity of Labour, Universal Brotherhood and Religious Tolerance, True Friendship, Happiness vs Suffering, Love for Truth, Aware of Self-Destructive Habits, Association and Cooperation, Doing Best for Saving Nature.

UNIT-V: Character and Wisdom

Character and Competence, Holy Books vs Blind Faith, Self-Management and Good Health, Science of Reincarnation, Equality, Nonviolence, Humility, Role of Women, All Religions and Same Message, Mind Your Mind, Self-Control, Honesty, Studying Effectively.

TEXT BOOKS:

1. Values and Ethics for Organizations: Theory and Practice, S. K. Chakraborty, Oxford University Press, 1st Edition, 1998 (paperback reprint 1999.
2. Value Education and Professional Ethics, R.R. Gaur, R. Sangal, G.P. Bagaria, Excel Books, 1st Edition, 2010.

REFERENCE BOOKS:

1. Education in Values: A Source Book, UNESCO, NCERT Publication, 1st Edition, 2002.
2. Value Education: Principles and Practice, S. Ignacimuthu, Don Bosco Publications, 1st Edition, 2009.
3. Value Education: Theory and Practice, G. Rajagopalan, Bharatiya Vidya Bhavan, 1st Edition, 2011.
4. Education for Values in Schools – A Framework, NCERT, NCERT Publication, 1st Edition, 2012.
5. Education in Human Values, A.C. Bhaktivedanta Swami Prabhupada, Bhaktivedanta Book Trust, 1st Edition, 2001.
6. Teaching of Values: Some Reflections, M. M. Goel, Shipra Publications, 1st Edition, 2005.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., I Year, II Semester
CONSTITUTION OF INDIA
(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic knowledge of Indian history and Governance

Course Objectives:

1. To provide a comprehensive understanding of the Indian Constitution, its structure, and significance.
2. To familiarize students with the fundamental rights, duties, and directive principles.
3. To introduce the key organs of government and their roles in a democratic system.
4. To promote awareness of constitutional values, governance mechanisms, and public responsibility.
5. To understand the relationship between the Constitution and the legal-administrative framework of India.

Course Outcomes: Students will be able to:

1. Describe the history, evolution, and philosophy behind the Constitution of India.
2. Explain the fundamental rights and duties of citizens and the structure of the Indian government.
3. Analyze the functioning of constitutional bodies and judicial systems.
4. Understand the significance of constitutional amendments and landmark legal cases.
5. Demonstrate responsible citizenship and awareness of constitutional governance

UNIT-I: Constitution Drafting History

History of Making of the Indian Constitution, History Drafting Committee, (Composition and Working)

UNIT-II: Constitutional Philosophy

Philosophy of the Indian Constitution**,** Preamble**,** Salient Features

UNIT-III: Rights and Duties Framework

Contours of Constitutional Rights and Duties, Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-IV: Organs of Governance

Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V: Local Administration

District's Administration Head, Role and Importance. Municipalities: Introduction, Mayor and Role of Elected Representative, CEO of Municipal Corporation. Panchayat Raj: Introduction, PRI: Zila Panchayat, Elected Officials and their Roles, CEO Zila Panchayat, Position and Role, Block Level, Organizational Hierarchy (Different Departments), Village Level, Role of Elected and Appointed Officials, Importance of Grass Root Democracy.

UNIT-VI: Election Commission

Role and Functioning, Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and Women.

TEXT BOOKS:

1. The Constitution of India (Bare Act), Government Publication, 1st Edition, 1950.
2. Dr. B. R. Ambedkar: Framing of Indian Constitution, Dr. S. N. Busi, Ava Publications, 1st Edition, 2016.

REFERENCE BOOKS:

1. Introduction to the Constitution of India, M. P. Jain, LexisNexis, 7th Edition, 2014.
2. Introduction to the Constitution of India, D. D. Basu, LexisNexis, 22nd Edition, 2015.
3. Indian Polity, M. Laxmikanth, McGraw-Hill Education, 6th Edition, 2021.
4. Our Constitution, Subhash Kashyap, National Book Trust, 1st Edition, 2011.
5. The Constitution of India: A Contextual Analysis, Arun K. Thiruvengadam, Bloomsbury Publishing, 1st Edition, 2017.
6. The Constitution of India, P.M. Bakshi, Universal Law Publishing, 17th Edition, 2020.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
PEDAGOGY STUDIES
(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic understanding of Teaching-Learning processes

Course Objectives:

1. To understand the concepts, principles, and theories of pedagogy and their application.
2. To evaluate the effectiveness of different teaching approaches in varied educational contexts.
3. To analyze the impact of teacher behavior, classroom environment, and instructional strategies on learning.
4. To assess the challenges in implementing pedagogical innovations in diverse settings.
5. To enable the design of learner-centered, inclusive, and effective educational practices.

Course Outcomes: Students will be able to understand

1. Explain key pedagogical theories and their relevance to classroom teaching.
2. Compare traditional and modern teaching strategies based on evidence from research.
3. Identify factors affecting student engagement, motivation, and learning outcomes.
4. Design instructional plans that incorporate effective pedagogical principles.
5. Critically evaluate and adapt teaching practices to meet diverse learner needs.

UNIT-I: Pedagogical Foundations

Introduction and Methodology, Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and searching.

UNIT-II: Global Pedagogical Practices

Thematic Overview, Pedagogical Practices are being used by Teachers in Formal and Informal Classrooms in Developing Countries, Curriculum, and Teacher Education.

UNIT-III: Effective Pedagogy Evidence

Evidence on the Effectiveness of Pedagogical Practices, Methodology for the In-depth Stage, Quality Assessment of Included Studies, How Can Teacher Education (Curriculum and Practicum) and the School Curriculum and Guidance Materials best Support Effective Pedagogy, Theory of Change, Strength and Nature of the body of Evidence for Effective Pedagogical Practices, Pedagogic Theory and Pedagogical Approaches, Teachers' Attitudes and Beliefs and Pedagogic Strategies.

UNIT-IV: Professional development

Alignment with Classroom Practices and Follow-Up Support, Peer Support, Support from the Head Teacher and the Community, Curriculum and Assessment, Barriers to Learning, Limited Resources and Large Class Sizes.

UNIT-V: Future Pedagogical Research

Research Gaps and Future Directions, Research Design**,** Contexts**,** Pedagogy**,** Teacher Education**,** Curriculum and Assessment**,** Dissemination and Research Impact.

TEXT BOOKS:

1. Classroom interaction in Kenyan primary schools. Ackers, J., and Hardman, F., Compare A Journal of Comparative and International Education, Volume 31, 2001.
2. Curricular reform in schools: The importance of evaluation, Agrawal, M, Journal of Curriculum Studies, Volume 36, 2003.

REFERENCE BOOKS:

1. Teacher training in Ghana - does it count? , Akyeampong, K, Multi-site teacher education research project (MUSTER) country report 1. Department for International Development (DFID), London, 1st Edition, 2003.
2. How Learning Works: Seven Research-Based Principles for Smart Teaching, Susan A. Ambrose, Jossey-Bass, 1st Edition, 2010.
3. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement, John Hattie, Routledge, 1st Edition, 2009.
4. Teaching for Quality Learning at University, John Biggs, Catherine Tang, McGraw-Hill Education, 4th Edition, 2011.
5. The Skillful Teacher: On Technique, Trust, and Responsiveness in the Classroom, Stephen D. Brookfield, Jossey-Bass, 3rd Edition, 2015.
6. Learning Theories: An Educational Perspective, Dale H. Schunk, Pearson Education, 7th Edition, 2015.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., II Year, I Semester
STRESS MANAGEMENT BY YOGA
(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic awareness of mental and physical health.

Course Objectives:

1. To introduce the concept of stress and its impact on physical and mental well-being.
2. To provide an understanding of yoga as a tool for stress relief and emotional balance.
3. To teach various yogic practices, including asanas, pranayama, and meditation for managing stress.
4. To cultivate self-awareness, relaxation, and resilience through regular yogic practice.
5. To promote a healthy lifestyle by integrating yogic discipline in daily life.

Course Outcomes: Students will be able to:

1. Understand the causes and physiological effects of stress.
2. Apply basic yogic techniques to reduce stress and enhance focus.
3. Practice breathing techniques and meditation to maintain emotional stability.
4. Demonstrate improved physical flexibility, mental clarity, and stress tolerance.
5. Incorporate yoga as a sustainable approach to managing academic, professional, and personal pressures.

UNIT-I:
Definitions of Eight parts of yoga. (Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III: Do`s and Don'ts in Life
Ahinsa, Satya, Astheya, Bramhacharya, and Aparigraha. Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan

UNIT-IV:
Aasan and Pranayam

UNIT-V:
Various Yoga Poses and their Benefits for Mind and Body. Regularization of Breathing Techniques and its Effects, Types of Pranayam

TEXT BOOKS:

1. Yogic Asanas for Group Training – Part I, Janardan Swami Yogabhyasi Mandal, Janardan Swami Yogabhyasi Mandal, Nagpur, Standard Edition, 1990.
2. Rajayoga or conquering the Internal Nature, Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata, 2010.

REFERENCE BOOKS:

1. The Heart of Yoga: Developing a Personal Practice, T.K.V. Desikachar, Inner Traditions, 1st Edition, 1999.
2. Yoga for Stress Relief, Swami Shivapremananda, Jaico Publishing House, 1st Edition, 2002.
3. Light on Yoga, B.K.S. Iyengar, HarperCollins, Revised Edition, 2015.
4. The Relaxation Response, Herbert Benson, HarperTorch, Updated Edition, 2000.
5. Yoga for Wellness, Shri Yogendra, The Yoga Institute, 1st Edition, 2001.
6. Yoga as Medicine, Timothy McCall, Bantam Books, 1st Edition, 2007.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., I Year, II Semester
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic Communication and Interpersonal Skills

Course Objectives:

1. To understand the concept of personality and its development through ethical and moral grounding.
2. To enhance self-awareness, confidence, and emotional intelligence.
3. To inculcate life-enlightening values drawn from Indian wisdom and philosophy.
4. To improve communication, leadership, and decision-making abilities.
5. To promote a positive attitude and holistic approach toward life and career.

Course Outcomes: Students will be able to

1. Explain the key elements of personality and factors influencing its growth.
2. Demonstrate improved self-confidence, empathy, and interpersonal relationships.
3. Apply principles from enlightened texts (e.g., Bhagavad Gita, Upanishads) to everyday decision-making.
4. Exhibit qualities of ethical leadership and responsible citizenship.
5. Lead a balanced, purposeful, and value-driven personal and professional life.

UNIT-I:

Neetisatakam-Holistic development of personality

1. Verses- 19,20,21,22 (wisdom)
2. Verses- 29,31,32 (pride & heroism)
3. Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

1. Verses- 52,53,59 (don'ts)
2. Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day-to-day work and duties.

1. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
2. Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
3. Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

1. Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68
2. Chapter 12 -Verses 13, 14, 15, 16,17, 18
3. Personality of the Role model. Shrimad Bhagwad Geeta:

UNIT-V:

1. Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
2. Chapter 4-Verses 18, 38,39
3. Chapter18 – Verses 37,38,63

TEXT BOOKS:

1. Srimad Bhagavad Gita, Swami Swarupananda, Advaita Ashram (Publication Department), Kolkata, 2018.
2. Bhartrihari's Three Satakas, (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi, 1st Edition, 2002.

REFERENCE BOOKS:

1. Awakening the Giant Within, Anthony Robbins, Free Press, 1st Edition, 1992
2. The 7 Habits of Highly Effective People, Stephen R. Covey, Simon and Schuster, 30th Anniversary Edition, 2020
3. Wings of Fire: An Autobiography, A.P.J. Abdul Kalam, Universities Press, 30th Impression, 2014
4. Living with the Himalayan Masters, Swami Rama, Himalayan Institute Press, Revised Edition, 2002
5. The Monk Who Sold His Ferrari, Robin Sharma, Jaico Publishing House, 1st Edition, 1997
6. The Power of Now, Eckhart Tolle, New World Library, 1st Edition, 1999.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., II Year, I Semester
BUSINESS ANALYTICS
(Open Elective)

L	T	P	C
3	0	0	3

Prerequisite: Statistics and Probability, Mathematics for Analytics

Course objectives:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision-making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools and Operations research techniques.

Course Outcomes: At the end of the course,

1. Understand and apply key business analytics concepts in various functional areas.
2. Analyze historical data using descriptive analytics for business reporting.
3. Develop predictive models to forecast business trends and customer behavior.
4. Apply prescriptive analytics techniques to support strategic decision-making.
5. Use tools such as Excel, R, Python, or Tableau for data analysis and visualization in a business setting.

UNIT- I: Business analytics

Overview of Business Analytics, Scope of Business Analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, Competitive Advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical Methods, Review of Probability Distribution and Data Modelling, Sampling and Estimation Methods Overview.

UNIT- II: Trendiness and Regression Analysis

Modelling Relationships and Trends in Data, Simple Linear Regression, Important Resources, Business Analytics Personnel, Data and Models for Business Analytics, Problem Solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT- III: Business Analytics Structure and Techniques

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT- IV: Forecasting Techniques

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting, Appropriate Forecasting Models, Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT- V: Decision Analysis

Formulating Decision Problems, Decision Strategies with and Without Outcome Probabilities, Decision Trees and Value of Information, Utility and Decision Making. Recent Trends in Embedded and Collaborative Business Intelligence, Visual Data Recovery, Data Storytelling and Data Journalism.

TEXT BOOKS:

1. Business Analytics: Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans, and Christopher M. Starkey, Pearson FT Press, 1st Edition, 2014.
2. Business Analytics, James R. Evans, Pearson Education, 3rd Edition, 2020.

REFERENCE BOOKS:

1. Business Analytics: Data Analysis and Decision Making, S. Christian Albright and Wayne L. Winston, Cengage Learning, 6th Edition, 2016.
2. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media, 1st Edition, 2013.
3. Business Analytics: The Science of Data-Driven Decision Making, U. Dinesh Kumar, Wiley India, 1st Edition, 2017.
4. Data Science for Business, Foster Provost, Tom Fawcett, O'Reilly Media, 1st Edition, 2013.
5. Predictive Analytics: The Future of Big Data, Eric Siegel, Wiley, 1st Edition, 2013.
6. Principles of Business Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson Education, 1st Edition, 2014.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY

M. Tech., II Year, I Semester

WASTE TO ENERGY

(Open Elective)

L	T	P	C
3	0	0	3

Prerequisites: Renewable Energy Engineering and Technology

Course Objectives:

1. To understand various types of waste and their energy potential.
2. To study the technologies used for converting waste into energy, including thermal, biological, and chemical processes.
3. To explore waste handling, segregation, and preprocessing techniques.
4. To evaluate the environmental and economic aspects of waste-to-energy (WTE) systems.
5. To examine policies, challenges, and case studies related to WTE implementation.

Course Outcomes:

1. Classify different types of waste and assess their suitability for energy recovery.
2. Explain and compare WTE technologies such as incineration, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery.
3. Analyze the performance and efficiency of WTE systems.
4. Assess environmental impacts and propose mitigation measures for WTE plants.
5. Design and evaluate small- and large-scale WTE projects considering technical and economic factors.

UNIT-I: Energy from Waste

Classification of Waste as Fuel, Agro-Based, Forest Residue, Industrial Waste, MSW, Conversion Devices, Incinerators, Gasifiers, and Digesters.

UNIT-II: **Biomass Pyrolysis**

Pyrolysis, Types, Slow Fast, Manufacture of Charcoal, Methods, Yields and Application, Manufacture of Pyrolytic Oils and Gases, Yields and Applications. Biomass Gasification: Gasifiers, Fixed Bed System, Downdraft and Updraft Gasifiers, Fluidized Bed Gasifiers, Design, Construction and Operation, Gasifiers Burner Arrangement for Thermal Heating, Gasifier Engine Arrangement and Electrical Power, Equilibrium and Kinetic Considerations in Gasifier Operation.

UNIT-III: **Biomass Combustion**

Biomass stoves, Improved Chullahs, Types, Some Exotic Designs, Fixed Bed Combustors, Types, Inclined Grate Combustors, Fluidized Bed Combustors, Design, Construction, and Operation, Operations of all the above Biomass Combustors.

UNIT-IV: Biogas

Properties of Biogas (Calorific Value and Composition), Biogas Plant Technology and Status, Bio Energy System, Design and Constructional Features, Biomass Resources and their Classification, Biomass Conversion Process.

UNIT-V: Biomass Conversion and Waste to Energy

Thermo Chemical Conversion, Direct Combustion, Biomass Gasification, Pyrolysis and Liquefaction, Biochemical Conversion, Anaerobic Digestion, Types of Biogas Plants, Applications: Alcohol Production from Biomass, Bio Diesel Production, Urban Waste to Energy Conversion, Biomass Energy Programme in India.

TEXT BOOKS:

1. Non-Conventional Energy, Ashok V. Desai, Wiley Eastern Ltd., 1st Edition, 1990.
2. Biogas Technology – A Practical Handbook, Vol. I & II, K.C. Khandelwal and S.S. Mahdi, Tata McGraw-Hill Publishing Co. Ltd., 1st Edition, 1983.

REFERENCE BOOKS:

1. Food, Feed and Fuel from Biomass, D.S. Challal, IBH Publishing Co. Pvt. Ltd., 1st Edition, 1991.
2. Biomass Conversion and Technology, C.Y. WereKo-Brobby and E.B. Hagan, John Wiley and Sons, 1st Edition, 1996.
3. Renewable Energy Engineering and Technology: Principles and Practice, V.V.N. Kishore, TERI Press, 1st Edition, 2009.
4. Biomass to Renewable Energy Processes, Jay Cheng, CRC Press, 2nd Edition, 2017.
5. Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Gary C. Young, Wiley, 1st Edition, 2010.
6. Anaerobic Digestion – Making Biogas – Making Energy: The Earthscan Expert Guide, Tim Pullen, Routledge, 1st Edition, 2015.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., II Year, I Semester
CONCURRENT ENGINEERING
(Open Elective)

L	T	P	C
3	0	0	3

Prerequisites: Computer-Aided Design

Course objective:

1. To introduce the concept of concurrent engineering and integrated product development.
2. To promote teamwork across functions such as design, manufacturing, and quality.
3. To apply concurrent engineering principles to optimize product design and performance.
4. To study tools and methodologies for real-time design decision-making.
5. To understand project management strategies for concurrent product realization.

Course Outcomes: At the end of the course, the student will be able to

1. Understand the need and benefits of concurrent engineering in product development.
2. Apply IT tools and collaborative platforms in engineering design.
3. Integrate lifecycle design and real-time analysis in concurrent engineering.
4. Use concurrent design strategies in manufacturing and assembly planning.
5. Manage product realization projects using concurrent engineering frameworks.

UNIT - I: CE and IT Applications

Introduction, Extensive Definition of CE, CE Design Methodologies, Organizing for CE, CE Toolbox, Collaborative Product Development.

Use Of Information Technology: IT Support, Solid Modeling, Product Data Management, Collaborative Product Commerce, Artificial Intelligence, Expert Systems, Software Hardware Co-Design.

UNIT - II: Life Cycle Design and Automation

Life Cycle Design of Products, Opportunity for Manufacturing Enterprises, Modality of Concurrent Engineering Design. Automated Analysis, Idealization Control, Concurrent Engineering in Optimal Structural Design, Real-Time Constraints.

UNIT - III: Manufacturing Concepts and Analysis

Manufacturing Competitiveness, Checking the Design Process, Conceptual Design Mechanism, Qualitative, Physical Approach, An Intelligent Design for Manufacturing System.

UNIT - IV: Assembly Planning and Project Management

JIT System, Low Inventory, Modular, Modeling and Reasoning for Computer-Based Assembly Planning, Design of Automated Manufacturing.

Project Management: Life Cycle Semi-Realization, Design for Economics, Evaluation of Design for Manufacturing Cost.

UNIT - V: Concurrent Mechanical Design

Decomposition in Concurrent Design, Negotiation in Concurrent Engineering Design Studies, Product Realization Taxonomy, Plan for Project Management on New Product Development, Bottleneck Technology Development.

TEXT BOOK:

1. Concurrent Engineering: Automation, Tools, and Techniques, Andrew Kusiak, Wiley John and Sons Inc., 1st Edition, 1992.
2. Concurrent Product and Process Design, David Ullman, CRC Press, 1st Edition, 2003.

REFERENCE BOOKS:

1. Integrated Product Development, Anderson MM and Hein, L. Berlin, Springer Verlog, 1st Edition, 1987.
2. Design for Concurrent Engineering, Cleetus, J., Concurrent Engineering Research Centre, Morgantown W V, 1st Edition, 1992.
3. Concurrent Engineering Fundamentals: Integrated Product and Process Organization, Prasad B. S., Prentice Hall, 2nd Edition, 2021.
4. Concurrent Engineering in Product Design and Development, I. Moustapha, New Age International, 1st Edition, 2022.
5. Collaborative Engineering: Theory and Practice, Peter T. L. Popov, Springer, 1st Edition, 2024.

SHADAN COLLEGE OF ENGINEERING & TECHNOLOGY
M. Tech., II Year, I Semester
INDUSTRIAL SAFETY
(Open Elective)

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Prerequisites: Industrial Engineering, Occupational Health and Safety Basics

Course Objectives:

1. To create awareness about hazards and risks in industrial environments.
2. To study safety management systems, accident prevention methods, and risk assessment.
3. To understand safety legislation, standards, and codes of practice.
4. To explore fire safety, electrical safety, and handling of hazardous materials.
5. To promote a safety culture and preventive strategies in industries.

Course Outcomes: At the end of the course, student will be able to:

1. Identify hazards and assess risks in various industrial settings.
2. Implement accident prevention and safety management practices.
3. Apply relevant safety standards, codes, and legal requirements.
4. Plan and execute emergency preparedness and disaster management measures.
5. Recommend safety improvements to enhance workplace health and safety.

UNIT- I: Industrial Safety and Hazard Prevention

Accident, Causes, Types, Results and Control, Mechanical and Electrical Hazards, Types, Causes And Preventive Steps / Procedure, Describe Salient Points of Factories Act 1948 for Health and Safety, Washrooms, Drinking Water Layouts, Light, Cleanliness, Fire, Guarding, Pressure Vessels, etc., Safety Color Codes, Fire Prevention and Firefighting, Equipment and Methods.

UNIT- II: Fundamentals of maintenance engineering

Definition and Aim of Maintenance Engineering, Primary and Secondary Functions and Responsibility of Maintenance Department, Types of Maintenance, Types and Applications of Tools used for Maintenance, Maintenance Cost and its Relation with Replacement Economy, Service Life of Equipment.

UNIT- III: Wear and Corrosion and their prevention

Wear Types, Causes, Effects, Wear Reduction Methods, Lubricants, Types and Applications, Lubrication Methods, General Sketch, Working and Applications of Screw Down Grease Cup, Pressure Grease Gun, Splash Lubrication, Gravity Lubrication, Wick Feed Lubrication, Side Feed Lubrication, Ring Lubrication. Definition, Principle and Factors Affecting the Corrosion, Types of Corrosion, Corrosion Prevention Methods.

UNIT- IV: Fault Tracing and Decision Tree Analysis

Fault Tracing-Concept and Importance, Decision Tree Concept, Need and Applications, Sequence of Fault-Finding Activities, Show as Decision Tree, Draw Decision Tree for Problems in Machine Tools, Hydraulic, Pneumatic, Automotive, Thermal and Electrical Equipment's such as Any One Machine Tool, Pump, Air Compressor, Internal Combustion Engine, Boiler, Electrical Motors, Types of Faults in Machine Tools and Their General Causes.

UNIT- V: Periodic and Preventive Maintenance

Periodic Inspection-Concept and Need, Degreasing, Cleaning and Repairing Schemes, Overhauling Mechanical Components, Overhauling Electrical Motor, Common Troubles and Remedies Electric Motor, Repair Complexities and Use, Definition, Need, Steps and Advantages Preventive Maintenance, Steps/Procedure for Periodic and Preventive Maintenance Machine Tools, Pumps, Air Compressors, Diesel Generating (DG) Sets. Program and Schedule Preventive Maintenance Mechanical and Electrical Equipment, Advantages of Preventive Maintenance, Repair Cycle Concept and Importance.

TEXT BOOKS:

1. Maintenance Engineering Handbook, Higgins and Morrow, Da Information Services, 1st Edition.
2. Maintenance Engineering, H.P. Garg, S. Chand and Company, 1st Edition, 1987.

REFERENCE BOOKS:

1. Pump-Hydraulic Compressors, Audels, McGraw-Hill Publication, 1st Edition.
2. Foundation Engineering Handbook, Hans Winterkorn, Chapman and Hall, London, 1st Edition, 1975.
3. Industrial Safety Management, L. M. Deshmukh, Tata McGraw-Hill, 1st Edition, 2010.
4. Safety Engineering, R. K. Jain & Sunil S. Rao, Khanna Publishers, 4th Edition, 2015.
5. Industrial Safety, Health and Environment Management Systems, R. K. Jain & Sunil S. Rao, Khanna Publishers, 2nd Edition, 2016.
6. Industrial Safety and Risk Management, S. K. Basu, Fire and Safety Association of India, 1st Edition, 2017.