

**GATES INSTITUTE OF TECHNOLOGY (AUTONOMOUS)***(Affiliated by JNTU ANANTAPUR A.P.)***GOOTY – 515 401 (A.P) INDIA**

B. Tech (Regular-Full Time)

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

MECHANICAL ENGINEERING**IV -Year COURSE STRUCTURE**

IV B. Tech I Semester

S.No	Course Code	Title	L	T	P	Credits
1	23MET20	AI & ML for Mechanical Engineering	3	0	0	3
2	23MBTU4a 23MBTU4b 23MBTU4c	Management Course- II 1.Business Ethics and Corporate Governance 2.E-Business 3.Management Science	2	0	0	2
3	23MET21a 23MET21b 23MET21c 23MET21d 23MET21e	Professional Elective-IV 1. Mechanical Vibrations 2. Finite Element Methods 3. Refrigeration & Air Conditioning 4. Mechatronics & MEMS 5. Power Plant Engineering	3	0	0	3
4	23MET22a 23MET22b 23MET22c 23MET22d 23MET22e	Professional Elective-V 1. Non Conventional Energy Sources 2. Automation & Robotics 3. Non-Destructive Testing 4. Total Quality Management 5. Smart Manufacturing	3	0	0	3
5		Open Elective - III	3	0	0	3
6		Open Elective – IV	3	0	0	3
7	23MEP15	Skill Enhancement Course Introduction to Drone Technology	0	1	2	2
8	23BST39	Audit Course Gender Sensitization	2	0	0	-
9	23MEP16	Internship Evaluation of Industry Internship	-	-	-	2
Total			19	1	02	21

Open Elective – III

S.No	Course Code	Course Name	Offered by the Dept.
1	23CET24	Building Materials and Services	CIVIL
2	23CET25	Environmental Impact Assessment	
3	23EET23	Smart Grid Technologies	EEE
4	23ECT12	Microprocessors and Microcontrollers	ECE
5	23CST32	Data Base Management Systems	CSE & Allied/IT
6	23CST18b	Cyber Security	
7	23CST23e	Agent AI Engineering	
8	23BST30	Wavelet transforms and its Applications	Mathematics
9	23BST31	Smart Materials And Devices	Physics
10	23BST34	Introduction to Quantum Mechanics	
11	23BST32	Green Chemistry And Catalysis For Sustainable Environment	Chemistry
12	23BST33	Employability Skills	Humanities

Open Elective – IV

S.No	Course Code	Course Name	Offered by the Dept.
1	23CET26	Geo-Spatial Technologies	CIVIL
2	23CET27	Solid Waste Management	
3	23EET25	Electric Vehicles	EEE
4	23ECT29	Transducers and Sensors	ECE
5	23CST33	Computer Networks	CSE & Allied/IT
6	23CST23d	Internet of Things	
7	23CST30d	AI Powered Application Development	
8	23CST34	Introduction to Quantum Computing	
9	23BST35	Financial Mathematics	Mathematics
10	23BST36	Sensors And Actuators For Engineering Applications	Physics
11	23BST37	Chemistry Of Nanomaterials and Applications	Chemistry
12	23BST38	Literary Vibes	Humanities

IV B.Tech. II Semester

S.No.	Course code	Title	Category	L	T	P	Credits
1	23MEP17	Internship		-	-		4
		Project					8
Total							12

B. TECH-ME-IV-I Sem

23MET20	AI & ML FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Knowledge of Artificial Intelligence, focusing on intelligent agents, problem-solving techniques, and state-space search approaches.
2	Understand and apply various problem-solving and search techniques, including uniform and heuristic search strategies in artificial intelligence.
3	Explore and apply local search techniques for solving Constraint Satisfaction Problems (CSPs) and adversarial search strategies to make optimal decisions.
4	Apply various statistical reasoning techniques for knowledge representation and reasoning in AI, as well as logic programming and reasoning methods.
5	Familiar in fundamental concepts of Machine Learning techniques, as well as classification, regression, clustering problems, and an introduction to neural networks and deep learning.

COURSE OUTCOMES On successful completion of this course the student will be able to

1	Design intelligent agents, define problems using state-space models, and apply AI techniques.	L1,L3,L6
2	Implement and compare different search algorithms (both uniform and heuristic), apply and analyze appropriate strategies for solving AI problems.	L3,L4,L5
3	Solve CSPs using local search methods and implement adversarial search algorithms to make optimal decisions in competitive game scenarios.	L2,L5,L6
4	Utilize statistical and logical reasoning methods, to represent knowledge and perform forward and backward reasoning in AI applications.	L1,L2,L3
5	Understanding and apply various machine learning techniques, along with an introduction to neural networks and deep learning.	L1,L2,L3

UNIT I

Introduction to Artificial Intelligence and Problem-Solving Agent: Problems of AI, AI technique, Tic – Tac – Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, and issues in the design of search programs.

UNIT II

Search Techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best -first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.

UNIT III

Constraint Satisfaction Problems and Game Theory: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT IV

Knowledge & Reasoning: Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Logic programming, Forward and backward reasoning.

UNIT V

Introduction to Machine Learning: Exploring sub-discipline of AI: Machine Learning, Supervised learning, Unsupervised learning, Reinforcement learning, Classification problems, Regression problems, Clustering problems, Introduction to neural networks and deep learning.

Text Books

1. S. Russell and P. Norvig, —Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2015.
2. Nils J. Nilsson, —Artificial Intelligence: A New Synthesis, 1st Edition, Morgan-Kaufmann, 1998.

Reference Books

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, —Artificial Intelligence, McGraw Hill, 3rd ed., 2017.
2. Patterson, —Introduction to Artificial Intelligence & Expert Systems, Pearson, 1st ed. 2015.
3. Saroj Kaushik, —Logic & Prolog Programming, New Age International, 1st edition, 2002.
4. Joseph C. Giarratano, Gary D. Riley, —Expert Systems: Principles and Programming, 4th Edition, 2007.

Online Learning Resources:

<https://nptel.ac.in/courses/113104517>

<https://nptel.ac.in/courses/127104664>

<https://nptel.ac.in/courses/110104164>

<https://nptel.ac.in/courses/106106226>

IV B.Tech I Semester

23MBTU4a	Management Course- II BUSINESS ETHICS AND CORPORATE GOVERNANCE	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES :The objectives of this course are	
1	To make the student understand the principles of business ethics
2	To enable them in knowing about the ethics in management
3	To facilitate the student's role in corporate culture
4	To impart knowledge about the fair-trade practices
5	To encourage the student in knowing about the corporate governance

Syllabus**UNIT-I: Ethics**

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior.. Value systems - Business Ethics - Types, Characteristics, Factors, Contradictions and Ethical Practices in Management - Corporate Social Responsibility – Issues of Management – Crisis Management.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand the meaning of loyalty and ethical Behavior
- Explain various types of Ethics
- Analyze issues & crisis of management

UNIT-II: ETHICS IN MANAGEMENT

Introduction- Ethics in production, finance, Human resource management and Marketing Management - The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures - Culture and Individual Ethics – professional ethics and technical ethics.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand the meaning of Ethics in various areas of management
- Compare and contrast professional ethics and technical ethics
- Develop ethical values in self and organization

UNIT-III : CORPORATE CULTURE

Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, shared values, beliefs and norms, rituals, symbols and language - Types of corporate culture, hierarchical culture, market driven culture – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change.

LEARNING OUTCOMES:- After completion of this unit student will

- Define corporate culture



- Understand the key elements of corporate culture
- Analyze organization leadership and corporate culture

UNIT- IV: LEGAL FRAME WORK

Law and Ethics -Agencies enforcing Ethical Business Behavior - Legal Impact – Environmental Protection, Fair Trade Practices, legal Compliances, Safeguarding Health and wellbeing of Customers – Corporate law, Securities and financial regulations, corporate governance codes and principles.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand Law and Ethics
- Analyze Different fair trade practices
- Make use of Environmental Protection and Fair Trade Practices

UNIT -V: CORPORATE GOVERNANCE

Introduction - Meaning – Corporate governance code, transparency & disclosure -Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory frame work - Corporate scams - Committees in India and abroad, corporate social responsibility. BoDs composition, Cadbury Committee - Various committees - Reports - Benefits and Limitations.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand corporate governance code
- Analyze role of auditors, board of directors and shareholders in corporate governance
- Implementing corporate social responsibility in India.

Text books.

1. Murthy CSV: Business Ethics and Corporate Governance, HPH July 2017
2. Bholananth Dutta, S.K. Podder – Corporation Governance, VBH. June 2010

Reference books

1. Dr. K. Nirmala, KarunakaraReaddy. *Business Ethics and Corporate Governance*, HPH
2. H.R.Machiraju: *Corporate Governance*, HPH, 2013
3. K. Venkataramana, *Corporate Governance*, SHBP.
4. N.M.Khandelwal. *Indian Ethos and Values for Managers*

COURSE OUTCOMES: At the end of the course, students will be able to		BTL
CO1	Understand the Ethics and different types of Ethics.	L2
CO2	Understand business ethics and ethical practices in management	L2
CO3	Understand the role of ethics in management	L2
CO4	Apply the knowledge of professional ethics & technical ethics	L3
CO5	Analyze corporate law, ethics, codes & principles	L4
CO6	Evaluate corporate governance & corporate scams	L5

BTL = Bloom's Taxonomy Level

**ONLINE RESOURCES:**

1. https://onlinecourses.nptel.ac.in/noc21_mg46/
2. <https://archive.nptel.ac.in/courses/110/105/110105138/>
3. https://onlinecourses.nptel.ac.in/noc21_mg54/
4. https://onlinecourses.nptel.ac.in/noc22_mg54/
5. <https://archive.nptel.ac.in/courses/109/106/109106117/>

23MBTU4b	E-Business (Elective-2 VII - SEMESTER)	L	T	P	C
		2	0	0	2

Course Objectives: The Objectives of this course are	
1	To provide knowledge on emerging concept on E-Business related aspect.
2	To understand various electronic markets & business models.
3	To impart the information about electronic payment systems & banking.
4	To create awareness on security risks and challenges in E-commerce.
5	To the students aware on different e-marketing channels & strategies.

Unit-I: Electronic Business

Introduction – Nature, meaning, significance, functions and advantages - Definition of Electronic Business - Functions of Electronic Commerce (EC)-Advantages & Disadvantages of E-Commerce –E-Commerce and E-Business, Internet Services, Online Shopping- E-Commerce Opportunities for Industries.

Learning Outcomes: -After completion of this unit student

- Understand the concept of E-Business
- Contrast and compare E-Commerce & E-Business
- Evaluate opportunities of E-commerce for industry

Unit-II: Electronic Markets and Business Models

Introduction –E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals -Business Models- Business to Business (B2B)-Business to Customers(B2C) - Business to Government(B2G)-Auctions-B2B Portals in India

Learning Outcomes: -After completion of this unit student will

- Understand the concept of business models
- Contrast and compare Vertical portal and Horizontal portals
- Analyze the B2B,B2C and B2G model

Unit-III: Electronic Payment Systems:

Introduction to electronic payment systems (EPS) -Types of electronic payments - Credit/debit cards, e-wallets, UPI, and crypto currencies -Smart cards and digital wallets: Features and usage -Electronic Fund Transfer (EFT): Role in business transactions -Infrastructure requirements and regulatory aspects of e-payments

Learning Outcomes: -After completion of this unit student will

- Understand the Electronic payment system
- Contrast and compare EFT and smart cards
- Analyze debit card and credit cards

Unit-IV:E-Security

Security risks and challenges in electronic commerce - Cyber threats - Phishing, hacking, identity theft, and malware - Digital Signatures & Certificates - Security protocols over public networks (HTTP, SSL, TLS) - Firewalls in securing e-business platforms.

Learning Outcomes: -After completion of this unit student will

- Understand E-Security
- Contrast and compare security protocols and public network
- Evaluate on Digital signature

Unit-V:E-Marketing:

Introduction – Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Market Research– – E-marketing planning: Online branding, social media marketing, and email marketing - E-business strategies: Digital advertising, content marketing, and analytics – E-Customer Relationship Management (eCRM) E-supply chain management (e-SCM)

Learning Outcomes: -After completion of this unit student will

- Understand the concept of online marketing
- Apply the knowledge of online marketing
- Compare e-CRM and e-SCM

Text Books:

1. Arati Oturkar&Sunil Khilari. *E-Business*. Everest Publishing House, 2022
2. P.T.S Joseph. *E-Commerce*, Fourth Edition, Prentice Hall of India, 2011

References:

1. Debjani, Kamallesh K Bajaj. *E-Commerce*, Second Edition Tata McGraw-Hill's, 2005
2. Dave Chaffey. *E-Commerce E-Management*, Second Edition, Pearson, 2012.
3. Henry Chan. *E-Commerce Fundamentals and Application*, RaymondLeathamWiley India 2007
4. S. Jaiswal. *E-Commerce* GalgotiaPublication Pvt Ltd., 2003.



COURSE OUTCOMES: At the end of the course student will be able to		BTL
CO1	Remember E-Business & its nature, scope and functions.	L1
CO2	Understand E-market-Models which are practicing by the organizations	L2
CO3	Apply the concepts of E-Commerce in the present globalized world.	L3
CO4	Analyze the various E-payment systems & importance of net banking.	L4
CO5	Evaluate market research strategies & E-advertisements.	L5
CO6	Understand importance of E-security & control	L2

BTL = Bloom's Taxonomy Level

Online Resources:

<https://www.slideshare.net/fatimahAlkreem/e-businessppt-67935771>

<https://www.slideshare.net/VikramNani/e-commerce-business-models>

<https://www.slideshare.net/RiteshGoyal/electronic-payment-system>

<https://www.slideshare.net/WelingkarDLP/electronic-security>

<https://www.slideshare.net/Ankitha2404/emarketing-ppt>



23MBTU4c	Management Science	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES : The objectives of this course are

1	To provide fundamental knowledge on Management, Administration, Organization & its concepts.
2	To make the students understand the role of management in Production
3	To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
4	To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
5	To make the students aware of the contemporary issues in modern management

UNIT- I: INTRODUCTION TO MANAGEMENT

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Elton Mayo's Human relations - **Organizational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand the concept of management and organization
- Apply the concepts & principles of management in real life industry.
- Analyze the organization chart & structure of an enterprise.

UNIT - II OPERATIONS MANAGEMENT

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- **Material Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - **Marketing Management** - Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand the core concepts of Operations Management
- Apply the knowledge of Quality Control, Work-study principles in real life industry.
- Evaluate Materials departments & Determine EOQ
- Analyze Marketing Mix Strategies for an enterprise.
- Create and design advertising and sales promotion

UNIT - III HUMAN RESOURCES MANAGEMENT (HRM)

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process - Employee Training and Development - methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

LEARNING OUTCOMES: At the end if the Unit, the students will be able to

- Understand the concepts of HRM, Recruitment, Selection, Training & Development
- Analyze the need of training
- Evaluate performance appraisal
- Design the basic structure of salaries and wages

UNIT - IV STRATEGIC & PROJECT MANAGEMENT

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management** - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand Mission, Objectives, Goals & strategies for an enterprise
- Apply SWOT Analysis to strengthen the project
- Analyze Strategy formulation and implementation
- Evaluate PERT and CPM Techniques

UNIT - V CONTEMPORARY ISSUES IN MANAGEMENT

Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management – employee engagement and retention - Business Process Re-engineering and Bench Marking - Knowledge Management – change management –sustainability and corporate social responsibility.

LEARNING OUTCOMES At the end if the Unit, the students will be able to

- Understand modern management techniques
- Apply Knowledge in Understanding in TQM, SCM
- Analyze CRM, BPR
- Evaluate change management & sustainability

Text Books:

1. Frederick S. Hillier, Mark S. Hillier. *Introduction to Management Science*, October 26, 2023
2. A.R Aryasri, *Management Science*, TMH, 2019

References:

1. Stoner, Freeman, Gilbert. *Management*, Pearson Education, New Delhi, 2019.
2. Koontz & Weihrich, *Essentials of Management*, 6/e, TMH, 2005.
3. Thomas N.Duening & John M.Ivancevich, *Management Principles and Guidelines*, Biztantra.
4. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2004.
5. Samuel C.Certo, *Modern Management*, 9/e, PHI, 2005



COURSE OUTCOMES: At the end of the course, students will be able to		BTL
CO1	Remember the concepts & principles of management and designs of organization in a practical world	L1
CO2	Understand the knowledge of Work-study principles & Quality Control techniques in industry	L2
CO3	Apply the process of Recruitment & Selection in organization.	L3
CO4	Analyze the concepts of HRM & different training methods.	L4
CO5	Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.	L5
CO6	Create awareness on contemporary issues in modern management & technology.	L3

BTL = Blooms Taxonomy Level

ONLINE RESOUECES:

1. <https://www.slideshare.net/slideshow/introduction-to-management-and-organization-231308043/231308043>
2. <https://nptel.ac.in/courses/112107238>
3. <https://archive.nptel.ac.in/courses/110/104/110104068/>
4. <https://archive.nptel.ac.in/courses/110/105/110105069/>
5. https://onlinecourses.nptel.ac.in/noc24_mgl12/

B.Tech (ME)– IV-I Sem

23MET21a	MECHANICAL VIBRATIONS (Professional Elective-IV)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Introduce fundamental concepts of vibration analysis, focusing on Single Degree Freedom (SDOF) systems and their solutions.
2	Develop understanding of forced vibration, resonance, and damping effects in Single Degree Freedom systems, including vibration isolation.
3	Explore the dynamics of Two Degree Freedom (2DOF) systems and their application in vibration absorbers and coupled systems.
4	Familiarize Multi Degree Freedom (MDOF) systems, methods for formulating equations of motion, and vibration analysis techniques
5	Explain vibration measurement tools, transducers, and exciters used in experimental vibration analysis.

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

1	Define, Understand and Solve problems related to undamped and damped free vibrations in Single Degree Freedom systems using classical and energy methods.	L1,L2,L3
2	Analyze forced vibrations in Single Degree Freedom systems under various excitation forces, apply and evaluate the concepts of transmissibility and isolation.	L3,L4,L5
3	Derive the equations of motion, calculate natural frequencies, modes of vibration, and understand their application in dynamic vibration absorbers.	L2,L3,L5
4	Formulate equations of motion, and perform modal analysis of free and forced vibrations. Apply vibration measurement tools to select appropriate exciters for vibration testing.	L4,L5,L6
5	Explain and evaluate the damping characteristics in vibrating systems, including the effects of viscous damping, Coulomb damping, and damping in whirling of shafts.	L2,L5,L6

UNIT I**Single Degree Freedom Systems**

Single Degree Freedom Systems: Un-damped free vibration: Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping. Coulomb damping, equivalent damping coefficient. Simple problems.

Whirling of shafts: Transverse vibrations: Dunkerley's lower bound approximation, Critical speed of shafts.

UNIT II**Forced vibrations of Single Degree Freedom Systems**

Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

UNIT III**Two Degree Freedom Systems:**

Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

UNIT IV**Multi Degree Freedom Systems:**

Lagrangian method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

**UNIT V****Vibration measurement and Applications**

Transducers: variable resistance transducers, Piezoelectric transducers, electro dynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electro dynamic shaker.

Textbooks:

1. Singiresu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018.
2. G.K.Groover, Mechanical Vibrations, Nemchand& Bro, 8/e, 2009.

Reference Books:

1. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986.
2. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996
3. William Thomson, Theory of Vibrations with Applications, 5/e, Pearson, 2008
4. William Weaver, Timeoshenko, and Young, Vibration Problems in Engineering, 5/e, John Wiley, 2013.
5. C. Nataraj, Vibration of Mechanical Systems, 1/e, Cenage Learning, 2012.

Online Learning Resources:

- <https://nptel.ac.in/courses/112107212>
- <https://nptel.ac.in/courses/112103111>
- <https://nptel.ac.in/courses/112103112>
- <https://nptel.ac.in/courses/101105081>
- <https://www.iare.ac.in/sites/default/files/PPT/MVSD%20PPT.pdf>
- https://www.iare.ac.in/sites/default/files/lecture_notes/MV_Lecture_Notes.pdf



B.Tech (ME)– IV-I Sem

23MET21b	FINITE ELEMENT METHODS (Professional Elective-I)	L	T	P	C
		3	0	0	3

Course Objectives: The objectives of this course is to	
1	Learn basic principles of finite element analysis procedure.
2	Gain knowledge of the concepts of Nodes and elements
3	Know the theory and characteristics of finite elements that represent engineering structures.
4	Apply finite element solutions to structural, thermal, and dynamic problems.
5	Develop the knowledge and skills to evaluate finite element analyses and apply design analysis Effectively.

COURSE OUTCOMES On successful completion of this course the students will be able to		
CO1	<i>Understand the concepts behind formulation methods in FEA</i>	L2, L3,L6
CO2	<i>Explain the concepts of Nodes and elements used in the analysis of beams and solve the simple problems</i>	L2, L4,L6
CO3	Understand the 2D stress analyses of the FEM method and solve the strain triangles.	L2,L4,L6
CO4	Apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.	L1, L3,L5
CO5	Identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer and fluid flow.	L1, L3,L5

UNIT I**Introduction to finite element methods**

Introduction to finite element methods for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Potential energy and equilibrium, Rayleigh-Ritz method, Formulation of Finite Element Equations.

One dimensional Problems: Finite element modelling of 1D bar elements coordinates and shape functions. Requirements for Convergence and Interpolation functions, Pascal's Triangle, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT II**1D Analysis of Trusses and Beams**

Analysis of trusses: Stiffness Matrix for 1D truss element, Stress Calculations and Problems with maximum of three elements.

Analysis of beams: Element Stiffness Matrix and Load vector for 1 D beam element, Hermite shape functions and simple problems.

UNIT III**2D Analysis**

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses.

Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

UNIT IV**Quadrilateral Elements & Thermal Analysis**

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, Modelling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration.

Steady state heat transfer analysis: One dimensional analysis of composite slab and fin.

**UNITV****Dynamic analysis**

Analysis of a 1D uniform shaft subjected to torsion – Simple problems

Dynamic analysis: Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

Textbooks:

1. T. Chandraputla, Ashok Belegundu, Introduction to Finite Element in Engineering, Pearson Publication 2011.
2. S.S.Rao, The Finite Element Methods in Engineering, Elsevier Butterworth -Heinemann, 2/e, 2011.
3. J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1993.

Reference Books:

1. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element Analysis, 3/e, John Wiley, New York, 1989.
2. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, 1982.
3. G.LakshmiNarasaiah, Finite Element Analysis, 1/e, B.S. Publications, 2008.
4. O C Zienkiewicz and R L Taylor, the Finite Element Method, 3/e. McGraw-Hill, 1989.

Online Learning Resources:

<https://nptel.ac.in/courses/112/104/112104193/>
<https://nptel.ac.in/courses/112/104/112104205/>
<https://nptel.ac.in/courses/105/105/105105041/>
<https://nptel.ac.in/courses/112/106/112106130/>
<https://nptel.ac.in/courses/112/103/112103295/>

**B.Tech (ME)– IV-I Sem**

23MET21c	REFRIGERATION & AIR CONDITIONING (Professional Elective-IV)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Present the fundamental concepts and laws of refrigeration systems including Carnot and air-based cycles.
2	Explain the working principles, components, and performance parameters of vapour compression refrigeration systems.
3	Knowledge of alternative refrigeration systems such as vapour absorption, steam jet, thermoelectric, and vortex refrigeration.
4	Understanding of psychrometric processes and air conditioning load calculations.
5	Familiarize with air conditioning components and the concept of human thermal comfort and heat pumps.

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

1	Define and explain the principles of refrigeration and analyze the performance of air refrigeration systems including aircraft applications.	L1,L2,L4
2	Apply thermodynamic principles to analyze and solve problems related to vapour compression refrigeration cycles using P-h and T-S diagrams.	L3,L4,L5
3	Describe the operation of various refrigeration systems, calculate theoretical COP and create the effective refrigeration system .	L2, L3,L6
4	Knowledge on psychrometric chart and evaluate air conditioning processes using psychrometric charts and analyze various cooling systems for different climates.	L1,L4,L5
5	Identify and select appropriate air conditioning equipment based on comfort requirements and system needs. Build an effective air conditioning system.	L2,L4,L6

UNIT I**Introduction to Refrigeration**

Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods.

Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems - Refrigeration Needs of Air Crafts.

UNIT II**Vapour Compression Refrigeration (VCR) System**

Vapour Compression Refrigeration (VCR) System - Basic Cycle - Working Principle and Essential Components of the Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Secondary Refrigerants- Lubricants - Ozone Depletion - Global Warming- Newer Refrigerants.

UNIT III**Vapor Absorption Refrigeration (VAR) System**

Vapor Absorption Refrigeration (VAR) System-Description and Working of NH₃ - Water System and Li Br -Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System

STEAM JET REFRIGERATION SYSTEM: Working Principle and Basic Components-Estimation of Motive Steam Required Principle and Operation of: (I) Thermo-Electric Refrigerator (ii) Vortex Tube or Hilsch Tube.

**UNIT IV****Introduction to Air Conditioning:**

Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts. Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

UNIT V**Air Conditioning Equipment**

Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers.

Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits. Energy efficient AC system Star Rating.

Textbooks:

1. Refrigeration and Air Conditioning, C P Arora, TMH, 15/e, 2013.
2. S. C Arora & Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpat rai & Co, 2018.

Reference Books:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2/e, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4/e, 2007
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2/e, 2012.
4. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4/e, 2013.

NOTE: Tables/Codes: Thermal Engineering Data Book containing refrigerant and Psychrometric property Tables and charts are permitted in Exam.

Online Learning Resources:

- https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RAC_Lecture_Notes.pdf
- <https://www.studocu.com/en-us/document/saint-louis-university/fluid-dynamics-laboratory/refrigeration-lecture-notes-1/3020577>
- <http://home.iitk.ac.in/~samkhan/ME340A.htm>
- <https://nptel.ac.in/courses/112105129>
- <http://dte.karnataka.gov.in/Institutes/gptkampli/GenericDocHandler/68-fc177b7d-f5d1-4580-b577-b1118df994f4.pdf>

**B.Tech (ME)– IV-I Sem**

23MET21d	MECHATRONICS AND MEMS (Professional Elective-IV)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	To introduce the concept of mechatronics and its significance in modern industrial applications.
2	To explain the working principles, characteristics, and selection of various types of sensors.
3	To describe different actuator systems and their integration in automation circuits.
4	To develop understanding of microprocessors, microcontrollers, and PLCs including programming and control logic.
5	To explore MEMS technologies, fabrication techniques, and their applications in miniaturized systems.

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

1	Define and explain the fundamental concepts and applications of mechatronics in industrial systems.	L1,L2, L3
2	Identify and analyze various types of sensors and their performance characteristics for specific applications.	L2,L4,L5
3	Design and evaluate actuator systems including hydraulic and pneumatic circuits for automation tasks.	L3,L5,L6
4	Understand and develop PLC ladder logic programs for industrial automation using sequencing, timers, counters, and analog I/O.	L2,L3,L6
5	Describe MEMS fabrication methods, apply and analyze the effect of scaling in micro electromechanical systems.	L2,L3,L4

UNIT I**Introduction**

Definition of Mechatronics, Need for Mechatronics in Industry, Objectives of mechatronics, mechatronics design process, Mechatronics key elements, mechatronics applications – Computer numerical control (CNC) machines, Tool monitoring systems, Flexible manufacturing system (FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

UNIT II**Sensors**

Static and dynamic characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

UNIT III**Actuators**

Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys, Selection criteria for actuators.

UNIT IV**Microprocessors, Microcontrollers and Programmable Logic Controllers**

Architecture of Microprocessor, Microcontroller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

UNIT V**Micro Electro Mechanical Systems (MEMS)**

History, Effect of scaling, Fabrication Techniques: Oxidation, Physical Vapor disposition, Chemical Vapor Deposition, Lithography, Etching, Wafer bonding, LIGA, DRIE, Applications: Lab on chip.

**Textbooks:**

1. Bolton, Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, 3/e, Pearson Education Press, 2005.
2. Devadas Shetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010.
3. N. Mahalik, MEMS, McGraw Hill Educations, 2017.

Reference Books:

1. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2004.
2. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005.
3. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010.
4. Mohammed Gad, MEMS; Design and Fabrication, CRC Press, 2010.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc22_me54/preview
- <https://nptel.ac.in/courses/112108092>
- <https://nptel.ac.in/courses/112101304>
- https://onlinecourses.nptel.ac.in/noc20_ee56/preview
- https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf,
<https://lecturenotes.in/subject/1176/mechatronics-and-mems>

**B.Tech (ME)– IV-I Sem**

23MET21e	POWER PLANT ENGINEERING (Professional Elective-IV).	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Familiarize the sources of energy, power plant economics and environmental aspects.
2	Outline the working components of different power plant.
3	Understand the working mechanism of diesel and gas turbine power plants.
4	Impart types of nuclear power plants, and outline working principle and advantages and hazards.
5	Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.

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

1	Outline sources of energy, power plant economics, and environmental aspects.	L2
2	Describe working components of a steam power plant.	L2
3	Illustrate the working mechanism of diesel and gas turbine power plants.	L2,
4	Summarize types of renewable energy sources and their working principle.	L2
5	Demonstrate the working principle of nuclear power plants.	L4

UNIT I

Introduction to the Sources Of Energy - Resources and Development of Power in India. Convectional and non- conventional energy sources, Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations.

UNIT II

Steam Power Plant : Introduction to Boilers- Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal - Overfeed and Under Feed Fuel Beds, Travelling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders

UNIT III

Diesel Power Plant: Diesel Power Plant, Construction, Plant lay out with auxiliaries, fuel storage.

GAS TURBINE PLANT: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

UNIT IV

Hydro Electric Power Plant: Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

Hydro Projects Plant: Types - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

UNIT V



Power from Non-Conventional Sources: Utilization of Solar Collectors- Working Principle, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.
Nuclear Power Station: Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation.

Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

TEXT BOOKS:

1. P.K. Nag, —Power Plant Engineering, 3rd edition, TMH, 2013.
2. Wakil, —Power plant technology, M.M.EI TMH Publications.

REFERENCE BOOKS:

1. Rajput, —A Text Book of Power Plant Engineering:, 4th edition, Laxmi Publications, 2012.
2. Ramalingam, —Power plant Engineering, Scitech Publishers, 2013
3. P.C. Sharma, —Power Plant Engineering, S.K. Kataria Publications, 2012.
4. Arora and S.Domakundwar, —A course in Power Plant Engineering, Dhanpat Rai & Co (p) Ltd, 2014.

Online Learning Resources:

<https://nptel.ac.in/courses/112107291>

https://youtube.com/playlist?list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&si=RQhZwEibgqXK2dRL

https://youtube.com/playlist?list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&si=LjgzdabT7tIsCwJC

<https://youtu.be/IdPTuwKEfmA?si=PyF04z9beiVGkXAS>

**B.Tech (ME)– IV-I Sem**

23MET22a	NON CONVENTIONAL ENERGY SOURCES (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	To introduce the principles of solar radiation and its measurement for energy applications.
2	To explain the types and working principles of solar energy collectors and storage systems.
3	To provide an understanding of various renewable energy sources including wind, biomass, and geothermal energy.
4	To explore ocean energy technologies and direct energy conversion systems like thermoelectric generators and fuel cells.
5	To assess the economic and environmental impacts of renewable energy systems and their integration into energy infrastructure.

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

1	Define and explain the fundamentals of solar radiation and analyze data using appropriate instruments and models.	L1,L2,L4
2	Compare different types of solar collectors and evaluate their thermal performance for various applications.	L3,L4,L5
3	Describe and apply renewable energy technologies such as solar heating, wind turbines, and biomass digesters to evaluate the renewable energy.	L2,L3, L5
4	Illustrate the principles and potential of ocean, geothermal, and mini-hydel energy to apply and create sustainable energy models.	L2,L3,L6
5	Analyze the principles and performance of direct energy conversion systems including fuel cells and MHD generators.	L1,L4,L5

UNIT – I

PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

UNIT-IV

BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India.

UNIT-V

OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.



DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, and principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

TEXT BOOKS:

1. Non-Conventional Energy Sources /G.D. Rai Khanna Publisher (
2. Energy Resources Utilization and Technologies, Anjaneyulu Yerramilli, Francis Tuluri, BS Publications, 2012

REFERENCES :

1. Renewable Energy Sources/ Twidell & Weir 3rd edition Routledge publisher (2015)
2. Non Conventional Energy Resources, B.H.Khan, McGrawHill, 2015
3. Solar Power Engineering/B.S.Magal Frank Kreith & J.F.Kreith.
4. Principles of Solar Energy/ Frank Krieth & John F Kreider.
5. Non-Conventional Energy/ Ashok V Desai/ Wiley Eastern

Online Learning Resources:

https://youtube.com/playlist?list=PL3QMEfkoIRFbGhXveCE7RFDBgY0_gRxkh&si=ZYwAnUNtmIwsIq

<https://youtube.com/playlist?list=PLfxYQ3zfSrafm79OhjA7hvdCgm29EKrcq&si=wBQZsw0JtePVc2f->

<https://youtube.com/playlist?list=PLcWcvGXrBFerV7f9oyuuX9RabYUuanGrK&si=TVHISydk9cPw5MsV>

B.Tech (ME)– IV-I Sem

23MET22b	AUTOMATION AND ROBOTICS (Professional Elective-V).	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	To introduce the fundamentals of industrial automation, its types, components, and strategies across manufacturing systems.
2	To explain the working of automated flow lines and the methods used in assembly line balancing and flexible automation.
3	To impart knowledge about industrial robots, their configurations, anatomy, and applications in manufacturing processes.
4	To develop an understanding of manipulator kinematics, homogeneous transformations, actuators, and sensors used in robotics.
5	To analyze manipulator dynamics and apply trajectory planning techniques for robotic motion and obstacle avoidance.

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

1	Explain the need, types, and elements of automation systems and analyze different levels of automation strategies in industry.	L1,L2,L4
2	Demonstrate the operation of automated flow lines and apply methods for assembly line balancing and optimization.	L2,L3,L4
3	Identify robotic components and describe their configuration, degrees of freedom, and industrial applications in various processes.	L1,L2,L3
4	Apply transformation techniques and D-H notation to solve problems in robot kinematics and evaluate actuator and sensor selection.	L2,L3,L5
5	Analyze robot dynamics using Jacobians and Euler formulations and develop suitable trajectories for obstacle-free motion.	L3,L5,L6

UNIT-I**Introduction to Automation:**

Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

UNIT –II**Automated flow lines:**

Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT- III**Introduction to Industrial Robotics:**

Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

**UNIT- IV****Manipulator Kinematics:**

Manipulator Kinematics, Homogenous transformations as applicable to rotation and translation - D-H notation, Forward inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton – Euler formulations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

UNIT- V**Robot Programming:**

Robot Programming, Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Text Books:

1. Automation , Production systems and CIM,M.P. Groover /4thEdition, Pearson education (2016)
2. Industrial Robotics - M.P. Groover, TMH (1996)

References:

1. Robotics , Fu K S, McGraw Hill, 4th edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering , Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal ,Oxford Press, 1/e, 2006
5. Robotics and Control , Mittal R K &Nagrath I J , TMH.

Online Learning Resources:**Web References:**

- http://www.cadcamfunda.com/cam_computer_aided_manufacturing
- <http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-> classnotes.pdf
- <http://nptel.iitm.ac.in/courses.php?branch=Mechanical>
- <http://academicearth.org/courses/introduction-to-robotics> Video references:-<http://nptel.iitm.ac.in/video.php?courseId=1052>

**B.Tech (ME)– IV-I Sem**

23MET22c	NON-DESTRUCTIVE TESTING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	To introduce the principles, types, and safety aspects of various non-destructive testing (NDT) techniques including radiographic and ultrasonic methods.
2	To explain the theory, equipment, and evaluation procedures for ultrasonic, liquid penetrant, eddy current, and magnetic particle tests.
3	To familiarize students with advanced thermal and infrared inspection techniques and their applications.
4	To examine the use of specialized materials, sensors, and methods in thermal and IR-based NDT techniques.
5	To explore the wide-ranging industrial applications of NDT in fields such as aerospace, automotive, railways, and pressure vessel inspection.

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

1	Demonstrate the working principles, equipment, and safety considerations in radiographic and ultrasonic NDT methods and apply and analyze the different methods.	L2,L3,L4
2	Apply appropriate NDT techniques such as liquid penetrant, eddy current, and magnetic particle testing to analyze defect detection to solve the problems.	L3,L4,L5
3	Analyze the effectiveness and limitations of various NDT methods in real-world testing scenarios and create the solutions.	L1,L4,L6
4	Evaluate and create thermal and infrared NDT methods for different materials and structural applications, especially in aerospace and electronics.	L2, L5,L6
5	Illustrate the application of NDT techniques in diverse industrial domains and recommend suitable testing methods for specific components.	L2, L3, L5

UNIT - I

Introduction to non-destructive testing: Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

UNIT - II

Ultrasonic test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT – III**Liquid penetrant, Eddy Current & Magnetic Particle Test**

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

**UNIT - IV****Infrared & Thermal Testing**

Infrared And Thermal Testing: Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography– Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

UNIT - V**Industrial Applications of NDE**

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Textbooks:

1. J Prasad, GCK Nair ,Non destructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983.
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993.

Reference Books:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007.
2. ASTM Standards, Vol 3.01, Metals and alloys.

Online Learning Resources:

1. <http://www.twivirtualacademy.com/online-courses/ndt/>
2. <https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-9872>
3. https://onlinecourses.nptel.ac.in/noc20_mm07/preview
4. <https://www.youtube.com/watch?v=dyMR58TZMbo>
5. <https://www.youtube.com/watch?v=Wam-Ewen3aQ>
6. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_NDT_LECTURE_NOTES.pdf
7. <https://lecturenotes.in/subject/390/non-destructive-testing>

**B.Tech (ME)– IV-I Sem**

23MET22d	TOTAL QUALITY MANAGEMENT (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	To introduce the fundamental concepts, definitions, and dimensions of quality and Total Quality Management (TQM).
2	To explore the evolution of quality management through historical perspectives and contributions of quality gurus.
3	To explain the core principles of TQM including customer satisfaction, employee involvement, and continuous improvement.
4	To analyze the various TQM tools such as Benchmarking, QFD, FMEA, Six Sigma, and their role in quality enhancement.
5	To provide an understanding of quality systems like ISO 9000, ISO 14000, QS 9000, and the processes for their implementation.

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

1	Define and explain the basic concepts of quality, quality costs, and the scope of Total Quality Management.	L1,L2,L3
2	Summarize the philosophies and contributions of TQM pioneers and evaluate barriers and enablers for TQM implementation.	L1,L2,L5
3	Apply TQM principles such as employee empowerment, customer satisfaction, and supplier partnerships to real-world business scenarios.	L3,L5,L6
4	Analyze the application of tools like QFD, FMEA, Six Sigma, and Benchmarking in improving product and process quality.	L3,L4,L6
5	Evaluate and formulate quality systems like ISO 9000 and ISO 14000, and design documentation and auditing processes.	L5,L6

UNIT - I

Introduction: Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

UNIT - II

Historical Review: Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

UNIT - III

TQM Principles: Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies.

UNIT - IV

TQM Tools: Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of



FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

UNIT - V

Quality Systems: Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Edition, CRC Press, 2017.

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Online Learning Resources:

- <https://www.youtube.com/watch?v=VD6tXadibk0>
- <https://www.investopedia.com/terms/t/total-quality-management-tqm.asp>
- <https://blog.capterra.com/what-is-total-quality-management/>
- <https://nptel.ac.in/courses/110/104/110104080/>
- https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- <https://nptel.ac.in/courses/110/104/110104085/>
- <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/>

B.Tech (ME)– IV-I Sem

23MET22e	SMART MANUFACTURING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Understand the fundamental concepts of Smart Manufacturing, Industry 4.0 and IoT in Manufacturing
2	Understand the fundamental concepts of Data Analytics and Artificial Intelligence in Manufacturing
3	Know about Smart Sensors, RFID, and Block chain in Manufacturing
4	Explain the techniques of Digital Twin & Simulation in Manufacturing
5	Familiarize Sustainable and Green Manufacturing

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

1	Define and explain the evolution of Smart Manufacturing, Industry 4.0 and IoT in Manufacturing	L1,L2,L6
2	Concepts of Data Analytics and Artificial Intelligence in Manufacturing	L2,L4
3	Apply knowledge of Smart Sensors, RFID, and Block chain in Manufacturing	L3,L5,L6
4	Summarise the techniques of Digital Twin & Simulation in Manufacturing	L2,L3,L5,
5	Importance of Sustainable and Green Manufacturing.	L1,L3,L6

Unit – I**Introduction to Smart Manufacturing**

Definition, Evolution, and Importance of Smart Manufacturing, Industry 4.0 and Its Impact on Manufacturing, Traditional vs. Smart Manufacturing, Key Technologies in Smart Manufacturing

Cyber-Physical Systems & Industrial IoT (IIoT)

Basics of Cyber-Physical Systems (CPS), Internet of Things (IoT) in Manufacturing, Smart Sensors and Actuators Communication Protocols (MQTT, OPC-UA, Modbus),

Unit – II**Data Analytics and Artificial Intelligence in Manufacturing**

Role of Big Data in Manufacturing, Machine Learning & Deep Learning for Smart Manufacturing, Predictive Maintenance and Anomaly Detection, Digital Twin Technology

Automation & Robotics in Smart Manufacturing

Industrial Automation: PLCs, SCADA, and DCS, Autonomous Robots and Cobots (Collaborative Robots), Additive Manufacturing (3D Printing), Case Studies of Smart Factories.

Unit – III**Cloud Computing and Edge Computing in Manufacturing**

Introduction to Cloud Computing for Manufacturing, Edge and Fog Computing in Real-time Manufacturing Systems, Cloud-based Manufacturing Execution Systems (MES)

Smart Sensors, RFID, and Block chain in Manufacturing

Role of Smart Sensors and RFID in Inventory Management, Blockchain for Secure Supply Chains Smart Contracts and Decentralized Manufacturing Systems

Unit- IV**Digital Twin & Simulation in Manufacturing**

Digital Twin Technology and Virtual Prototyping, Simulation Software for Smart Manufacturing, Augmented Reality (AR) and Virtual Reality (VR) in Industry 4.0

Cybersecurity in Smart Manufacturing

Threats and Risks in Smart Manufacturing, Cybersecurity Frameworks for Industrial Systems, Best Practices for Securing IoT and IIoT Devices

Unit – V**Sustainable and Green Manufacturing**

Energy Efficiency in Smart Manufacturing, Sustainable Supply Chain Management, Role of AI in Green Manufacturing

Case Studies and Future Trends

Case Studies of Leading Smart Manufacturing Companies, Emerging Technologies in Smart Manufacturing, Future of Industry 5.0 and Beyond

Text Books:

1. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013
2. Smart manufacturing by Kamalakar Mutalik The Righte order (2023)

Reference Books:

1. Introduction To Smart Manufacturing And Automation Dr. Rajkumar. E Namya Press (29 March 2024); 213, Vardan Hosue 7/28 Ansari Road Daryganj Delhi 110002.
2. Smart Manufacturing by Michael Deng (Author), Colin Koh Kindle Edition (2023)

Online Learning Resources:

- [https://www.youtube.com/watch?v=sdgI072DJNM&pp=ygUUU01BUIQgTUFOVUZBQ1RVUklORyA%3D\(2023\)](https://www.youtube.com/watch?v=sdgI072DJNM&pp=ygUUU01BUIQgTUFOVUZBQ1RVUklORyA%3D(2023))

23MEP15	INTRADUCTION TO DRONE TECHNOLOGIES (Skill Enhancement Course)	L	T	P	C
		0	1	2	2

COURSE OBJECTIVES:

1. To learn and understand the fundamentals of design, fabrication and programming of drone
2. To teach technical characteristics of the Drone parts and its functions
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone

CO3: Select appropriate sensors and actuators for Drones

CO4: Develop a drone mechanism for specific applications

CO5: Create the programs for various drones

UNIT I
INTRODUCTION TO DRONE TECHNOLOGY

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT II
DRONE DESIGN, FABRICATION AND PROGRAMMING

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts -Assembling a drone- The energy sources- Level of autonomy-Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection

UNIT III
DRONE FLYING AND OPERATION

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT IV
DRONE COMMERCIAL APPLICATIONS

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT V
FUTURE DRONES AND SAFETY



The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TEXT BOOKS

1. Daniel Tal and John Altschuld, —Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation, 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, —Make:Getting Started with Drones —,Maker Media, Inc,

REFERENCES

1. John Baichtal, —Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, Que Publishing, 2016
2. Završnik, —Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance, Springer, 2018.

Learning resources

<https://nptel.ac.in/courses/101108661>

<https://www.youtube.com/watch?v=iJnuTtUFiWM>

B.Tech (ME)– IV-I Sem

23BST39	GENDER SENSITIZATION (AUDIT COURSE). (Common to All Branches of Engineering)	L	T	P	C
		2	0	0	0

Course Objectives:

- To enable students to understand the gender related issues, vulnerability of women and men
- To familiarize them about constitutional safeguard for gender equality
- To expose the students to debates on the politics and economics of work
- To help students reflect critically on gender violence
- To make them understand that gender identities and gender relations are part of culture as they shape the way daily life is lived in the family as well as wider community and the workplace.

Course Outcomes (CO):

COs	Statements	Bloom's level
CO1	Understand the basic concepts of gender and its related terminology	L1, L2,
CO2	Identify the biological, sociological, psychological and legal aspects of gender.	L1, L2
CO3	Use the knowledge in understanding how gender discrimination works in our society and how to counter it.	L3
CO4	Analyze the gendered division of labour and its relation to politics and economics.	L4
CO5	Appraise how gender-role beliefs and sharing behaviour are associated with more well-being in all culture and gender groups	L5
CO6	Develop students' sensibility with regard to issues of gender in contemporary India	L3

Unit-1 UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

Unit-2 GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and its Consequences-Declining Sex Ratio- Demographic Consequences-Gender Spectrum -

Unit-3 GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- —My Mother doesn't Work. —Share the Load. —Work: Its Politics and Economics -Fact and Fiction- Unrecognized and Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

Unit-4 GENDER-BASED VIOLENCE



The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence

Unit-5 GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language- Just Relationships

Prescribed Books

1. A.Suneetha, Uma Bhugubanda, et al. *Towards a World of Equals: A Bilingual Textbook on Gender*, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. UK Paperback Edn. March 1990

Reference Books

1. Wtatt, Robin and Massood, Nazia, *Broken Mirrors: The dowry Problems in India*, London : Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), *Women in Developing Countries, Assessing Strategies for Empowerment*, London: Lynne Rienner Publishers, 2002
3. Brush, Lisa D., *Gender and Governance*, New Delhi, Rawat Publication, 2007
4. Singh, Direeti, *Women and Politics World Wide*, New Delhi, Axis Publications, 2010
5. Raj Pal Singh, Anupama Sihag, *Gender Sensitization: Issues and Challenges* (English, Hardcover), Raj Publications, 2019
6. A.Revathy& Murali, Nandini, *A Life in Trans Activism*(Lakshmi Narayan Tripathi). The University of Chicago Press, 2016

Online Resources:

1. Understanding Gender chrome-extension:
[//kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/kamla-gender1.pdf](https://kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/kamla-gender1.pdf)

https://onlinecourses.swayam2.ac.in/nou24_hs53/preview

2. Gender Roles and Relations

<https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/what-are-gender-roles-and-stereotypes>

<https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our-relationships-7499408>

https://onlinecourses.swayam2.ac.in/cec23_hs29/preview

3. Gender and Labour

<https://www.economicsobservatory.com/what-explains-the-gender-division-of-labour-and-how-can-it-be-redressed>

https://onlinecourses.nptel.ac.in/noc23_mg67/preview

4. GENDER-BASED VIOLENCE

https://eige.europa.eu/gender-based-violence/what-is-gender-based-violence?language_content_entity=en

<https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and-girls>

https://onlinecourses.swayam2.ac.in/nou25_ge38/preview

5. GENDER AND CULTURE

<https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/>

<https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/>

<https://archive.nptel.ac.in/courses/109/106/109106136/>

Abdulali Sohaila. —I Fought For My Life...and Won. Available online
(at: <http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/>)

IV B.Tech I Sem

23MET23	3D PRINTING TECHNOLOGIES (Open Elective-III). (Common for CSE, CSE-Allied, ECE, EEE, and CE)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Understand the fundamental concepts of prototyping and distinguish between traditional and rapid prototyping methods.
2	Demonstrate the working principles, materials, and applications of solid-, liquid-, and powder-based RP systems.
3	Define the processes and classifications of rapid tooling and reverse engineering techniques.
4	Identify common errors in 3D printing and evaluate pre-processing, processing, and post-processing issues.
5	Familiarize RP-related software and its role in applications such as design, manufacturing, and medical fields.

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

1	Define and explain the evolution and need for rapid prototyping in modern product development.	L1,L2,L6
2	Compare and contrast various 3D printing technologies based on working principles, materials, and limitations.	L2,L4
3	Apply knowledge of rapid tooling and reverse engineering techniques for industrial and design applications.	L3,L5,L6
4	Diagnose and interpret different types of errors encountered in 3D printing processes and recommend solutions.	L2,L3,L5
5	Use RP-specific software tools to manipulate STL files and prepare models for printing in real-world scenarios.	L1,L3,L6

UNIT I Introduction to 3D Printing

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP. The Principle of Layer-Based Technology.

UNIT II Solid and Liquid Based RP Systems

Working Principle, Materials, Advantages, Limitations and Applications of Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereo lithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

UNIT III Powder Based & Other RP Systems

Powder Based RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM).

Other RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Three Dimensional Printing (3DP), Ballistic Particle Manufacturing (BPM) and Shape Deposition Manufacturing (SDM).

UNIT IV Rapid Tooling & Reverse Engineering

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development

UNIT V

Errors in 3D Printing and Applications:

Pre-processing, processing and post-processing errors, Part building errors in SLA, SLS, etc. Software: Need for software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP. Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Textbooks:

1. Chee Kai Chua and Kah Fai Leong, —3D Printing and Additive Manufacturing Principles and Applications|| 5/e, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, —Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing||, Springer, 2/e, 2010.

Reference Books:

1. Frank W.Liou, —Rapid Prototyping & Engineering Applications||, CRC Press, Taylor & Francis Group, 2011.
2. Rafiq Noorani, —Rapid Prototyping: Principles and Applications in Manufacturing||, John Wiley&Sons, 2006.

Online Learning Resources:

- NPTEL Course on Rapid Manufacturing.
- <https://nptel.ac.in/courses/112/104/112104265/>
- <https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/>
- <https://slideplayer.com/slide/6927137/>
- <https://www.mdpi.com/2073-4360/12/6/1334>
- <https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf>
- <https://lecturenotes.in/subject/197>
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdfcompressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- <https://www.youtube.com/watch?v=NkC8TNts4B4>.

IV B.Tech I Sem

23MET24	TOTAL QUALITY MANAGEMENT (Open Elective-IV). (Common for CSE, CSE-Allied, ECE, EEE, and CE)	L	T	P	C
		3	0	0	3

Course objectives: The objectives of the course are to

1	Familiarize the basic concepts of Total Quality Management.
2	Expose with various quality issues in Inspection.
3	Gain Knowledge on quality control and its applications to real time..
4	Understand the extent of customer satisfaction by the application of various quality concepts.
5	Demonstrate the importance of Quality standards in Production

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

1	Define and develop on quality Management philosophies and analyze quality costs frameworks.	L1,L3,L4
2	Understanding of the historical development of Total Quality Management (TQM), implementation, and real-world applications through case studies.	L2, L3,L6
3	Evaluate the cost of poor quality, process effectiveness and efficiency to analyze areas for improvement.	L2,L4,L5
4	Apply benchmarking and business process reengineering to improve management processes.	L3,L5,L6
5	Demonstrate the set of indications to evaluate performance excellence of an organization	L1,L2,L5

UNIT – I Introduction:

Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

UNIT - II Historical Review:

Historical Review: Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

UNIT – III TQM Principles:

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures Basic Concepts, Strategy, Performance Measure Case studies.

UNIT - IV TQM Tools:

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD)
 – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM)
 – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

UNIT – V Quality Systems:

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E. Ross, Total Quality Management, Third Edition, CRC Press, 2017.

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L. Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4. Samuel Ho, TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Online Learning Resources:

- <https://www.youtube.com/watch?v=VD6tXadibk0>
- <https://www.investopedia.com/terms/t/total-quality-management-tqm.asp>
- <https://blog.capterra.com/what-is-total-quality-management/>
- <https://nptel.ac.in/courses/110/104/110104080/>
- https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- <https://nptel.ac.in/courses/110/104/110104085/>
- <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/>

IV B.Tech I Sem

23EET23	SMART GRID TECHNOLOGIES (Open Elective- III) (EEE Branch)	L	T	P	C
		3	0	0	3

Course Objectives:

1. **Understand the fundamentals of Smart Grid technology**, its evolution, architecture, enabling technologies, and the need for modernization of conventional power systems.
2. **Analyze Wide Area Monitoring Systems (WAMS)**, including synchrophasor technology, PMUs, PDCs, and their applications in power system monitoring and blackout analysis.
3. **Explain the operation and applications of Smart Meters and Advanced Metering Infrastructure (AMI)** for demand-side management, power quality improvement, and outage management.
4. **Evaluate communication technologies and protocols used in Smart Grids**, including radio, mobile, power line, and optical fiber communication systems.
5. **Assess Smart Grid applications, energy storage technologies, renewable energy integration, and cyber security requirements** for reliable and secure smart grid operation.

Course Outcomes:

CO1:Understanding the Concept and Evolution of Smart Grids. L2

CO2:Analyzing Wide Area Monitoring System and Synchrophasor Technology. L4

CO3:Applying Smart Metering and Advanced Metering Infrastructure (AMI) Concepts. L3

CO4:Evaluating Information and Communication Technology (ICT) Systems in Smart Grids.L5

CO5:Designing Smart Grid Applications and Cybersecurity Measures. L6

UNIT I Introduction to Smart Grid :

Evolution of Electric Grid – Need for Smart Grid – Difference between conventional & smart grid – Overview of enabling technologies – International experience in Smart Grid deployment efforts – Smart Grid road map for India – Smart Grid Architecture.

UNIT II Wide Area Monitoring System :

Fundamentals of Synchro phasor Technology – concept and benefits of Wide Area Monitoring System – Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor applications (NAPSI) – Operational experience and Blackout analysis using PMU - Case study on PMU.

UNIT III Smart Meters:

Features and functions of Smart Meters – Functional specification – category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power Quality management.

UNIT IV Information and Communication Technology:

Overview of Smart Grid Communication system – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid.

UNIT V :Smart Grid Applications and Cyber Security:

Applications : Overview and concept of Renewable Integration – Introduction to distributed generation- Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow battery – Fuel cell – SMES – Super capacitors – Plug – in Hybrid electric Vehicles - Cyber Security: Security issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems –



Approach to assessment of smart grid cyber security risks – Methodologies. Cyber Security requirements – Smart Grid Information Model.

TEXT BOOKS:

1. James Momoh, "SMART GRID : Fundamentals of Design and Analysis", John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons, New Jersey, 2012.

REFERENCES:

1. Power Grid Corporation of India Limited, "Smart Grid Primer", 1st Edition, Power Grid Corporation of India Limited, Bangalore, India, 2013.
2. Fereidoon.P.Sioshansi, "Smart Grid – Integrating Renewable, Distributed and Efficient Energy", 1st Edition, Academic Press, USA, 2011.
3. Stuart Borlase, "Smart Grids: Infrastructure, Technology and Solutions", 1st Edition, CRC Press Publication, England, 2013.
4. Phadke A G, Thorp J S, "Synchronized Phasor Measurements and Their Applications", 1st Edition, Springer, Newyork, 2012.

IV B.Tech I Semester

23CST23e	Agentic AI Engineering (Open Elective –III) (CSE & Allied/IT Branch)	L	T	P	C
		3	0	0	3

Prerequisite: Knowledge of Python programming and Artificial Intelligence concepts. **Course Objectives:**

- To provide foundational knowledge of intelligent AI agents, their architectures, and operational principles.
- To equip students with the skills to design, develop, and orchestrate AI agents using modern frameworks and platforms.
- To enable students to build, deploy, and evaluate agentic AI solutions for real-world applications.

Course Outcomes:

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

CO1 : Explain the principles, architectures, and types of intelligent AI agents.

CO2 : Develop AI agents using memory management, tool calling, and agent development platforms.

CO3: Build LLM-powered agents using planning, orchestration, RAG, and workflow automation techniques.

CO4: Analyze the coordination, collaboration, and workflow design of multi-agent systems.

CO5: Analyze agent deployment architectures and emerging trends in Agentic AI.

Unit I: Foundations of AI Agents

Lecture 9 Hrs

Evolution of AI Agents and Agentic AI, Characteristics and Architecture of Intelligent Agents, Types of AI Agents, Agent Environment and Lifecycle, Reasoning and Decision-Making Concepts, Applications of AI Agents.

Unit II: Agent Design and Development

Lecture 8 Hrs

Goal-Oriented and Task-Oriented Agents, Agent Memory and Context Management, Tool Calling and Function Calling, Coding Agents using Frameworks and Developing Agents using Low-Code/No-Code Platforms (n8n, Zapier, Make), Designing Domain-Specific Agents, Agent Testing and Evaluation.

Unit III: LLM-Powered Agents and Agent Workflows

Lecture 9 Hrs

Large Language Models as Agent Brains, Agent Planning and Task Decomposition, Agent Orchestration and Workflow Management, Retrieval-Augmented Generation (RAG) for Agents, Workflow Automation using AI Agents, AI Coding and Knowledge Agents, Human-in-the-Loop Systems.

Unit IV: Multi-Agent Systems and Collaboration**Lecture 8 Hrs**

Fundamentals of Multi-Agent Systems, Agent Coordination and Collaboration, Multi-Agent Workflow Design, Enterprise Workflow Automation, Enterprise AI Agent Applications, Case Studies of Multi-Agent Solutions.

Unit V: Agent Deployment and Emerging Trends**Lecture 8 Hrs**

Agent Deployment Architectures, Monitoring and Maintenance of Agent Systems, Emerging Trends in Agentic AI.

Design and Development of Multi-Agent Systems for Domain-Specific Applications such as Banking, Agriculture, Healthcare.

Text Books

1. Karthik Ramgopal, Designing Autonomous AI Agents, O'Reilly Media, 2024.
2. Paul Iusztin and Maxime Labonne, AI Engineering: Building Applications with Foundation Models, O'Reilly Media, 2025.

Reference Books

1. Valentino Zocca and Ram Sriharsha, Building LLM Powered Applications, Packt Publishing, 2024.
2. Jay Alammam and Maarten Grootendorst, Hands-On Large Language Models, O'Reilly Media, 2024.
3. Michael Wooldridge, An Introduction to MultiAgent Systems, 2nd Edition, Wiley, 2009.
4. Noah Gift and Alfredo Deza, Practical MLOps: Operationalizing Machine Learning Models, 2nd Edition, O'Reilly Media, 2024.

IV B.Tech I Semester

23CST23d	INTERNET OF THINGS (Open Elective-IV) (CSE & Allied/IT Brach)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the basics of Internet of Things and protocols.
- Discuss the requirement of IoT technology
- Introduce some of the application areas where IoT can be applied.
- Understand the vision of IoT from a global perspective, understand its applications, determine its market perspective using gateways, devices and data management

Course Outcomes:

After completion of the course, students will be able to

- Understand general concepts of Internet of Things.
- Apply design concept to IoT solutions
- Analyze various M2M and IoT architectures
- Evaluate design issues in IoT applications
- Create IoT solutions using sensors, actuators and Devices

UNIT- I Introduction to IoT

Lecture 9Hrs

Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoT communication models, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates

UNIT- II Prototyping IoT Objects using Microprocessor/Microcontroller Lecture 8Hrs

Working principles of sensors and actuators, setting up the board – Programming for IoT, Reading from Sensors, Communication: communication through Bluetooth, Wi-Fi.

UNIT-III IoT Architecture and Protocols

Lecture 9Hrs

Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, Protocols- 6LoWPAN, RPL, CoAP, MQTT, IoT frameworks- Thing Speak.

UNIT- IV Device Discovery and Cloud Services for IoT

Lecture 8Hrs

Device discovery capabilities- Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.

UNIT- V UAV IoT

Lecture 9Hrs

Introduction to Unmanned Aerial Vehicles/Drones, Drone Types, Applications: Defense, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller(ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones(IoD)- Case study FlytBase.

Text books:

1. Vijay Madiseti and Arshdeep Bahga, “ Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Handbook of unmanned aerial vehicles, K Valavanis; George J Vachtsevanos, New York, Springer, Boston, Massachusetts : Credo Reference, 2014. 2016.

Reference Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “ From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. ArshdeepBahga, Vijay Madiseti - Internet of Things: A Hands-On Approach, Universities Press, 2014.
3. The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.
4. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
5. Cuno Pfister, Getting Started with the Internet of Things, O’Reilly Media, 2011, ISBN: 9781-4493- 9357-1
6. DGCA RPAS Guidance Manual, Revision 3 – 2020
7. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

Online Learning Resources:

1. <https://www.arduino.cc/>
2. <https://www.raspberrypi.org/>
3. <https://nptel.ac.in/courses/106105166/5>
<https://nptel.ac.in/courses/108108098/4>


IV B.Tech. II Semester

S.No.	Course code	Title	Category	L	T	P	Credits
1	23MEP16	Internship		-	-		4
		Project					8
Total							12