COURSESTRUCTURE AND
DETAILED SYLLABUS

for

COMPUTER-INTEGRATED MANUFACTURING

1st & 2nd M. TECH
DEGREE PROGRAMME

APPLICABLE FOR THE BATCHES
ADMITTED FROM 2026

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AR 26

DEPARTMENT OF MECHANICAL ENGINEERING
ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
Approved by AICTE,recognised Under (2f)&(12b) of UGC
Permanently affiliated to JNTUGV, Vizianagaram
K.Kotturu, Tekkali, Srikakulam-532201, ANDHRAPRADESH.

WWW.adityatekkali.edu.in

Department

Of

Mechanical

Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

The Department of **Mechanical Engineering** (ME) at **Aditya Institute of Technology and Management** was established in 2004 with an initial intake of 60 students. An additional intake of 60 seats was approved in the academic year 2011–12. A postgraduate programme M.Tech. in Thermal Engineering, was also introduced in 2011–12 with an intake of 18 students. The B.Tech. intake was enhanced to 180 in 2019 and later rationalized to 120 in 2022. A new **M.Tech.** programme in **Computer Integrated Manufacturing** was introduced in 2025 with an intake of 12 students, further strengthening the department's postgraduate and research profile.

The institution has been accredited by NAAC with an A+ grade. The college also received TEQIP funds under Phase-II, Sub-component 1.1, with the department receiving a major share to improve the teaching-learning process. These achievements have enhanced the prestige of the institution and the department, thereby helping students improve their academic standards. Both the B.Tech. and M.Tech. programmes are approved by AICTE and the Government of Andhra Pradesh and are permanently affiliated to JNTU-GV, Vizianagaram. The UG Mechanical Engineering programme has been accredited by NBA four times—under Tier-II in 2013 and 2017, and under Tier-I in 2021 and 2024—reflecting sustained academic excellence.

The department is recognized as a Research Centre by JNTU-GV and demonstrates strong research potential, with 12 faculty members holding Ph.D. degrees and 11 faculty members currently pursuing their Ph.D. In addition, five research scholars are actively working towards their doctoral degrees. The department is equipped with skill-oriented laboratories, including a Siemens-PLM Authorized Training Centre and an Applied Robot Control Lab in association with the European Centre for Mechatronics and Manufacturing, Germany. State-of-the-art laboratories such as the 3DX Lab from Dassault Systèmes, Automobile Lab, and Refrigeration and Air Conditioning Lab, established in association with the Andhra Pradesh State Skill Development Centre, are valuable assets to the department. These facilities help enhance the practical skills and employability of students.

Over the years, the Department of Mechanical Engineering has been progressing steadily with significant growth in both academic and research activities.

VISION OF THE DEPARTMENT

To emerge as one of the most preferred departments in the Southern region to produce professionally competent mechanical engineers.

MISSION OF THE DEPARTMENT

- Provide students with a set of necessary knowledge, skills and attitude.
- Develop the professional potential of students through comprehensive teaching and learning processes.
- Inculcate life-long learning among the students to serve the profession and meet intellectual, ethical and career challenges.
- Establish vital, state-of-the-art research facilities to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: Build successful careers in Computer Integrated Manufacturing, Advanced Manufacturing, Design, Automation, Robotics, and Allied engineering Disciplines.

PEO 2: Develop innovative manufacturing methods, processes, and technological solutions to address contemporary industrial and societal challenges.

PEO 3: Exhibit research aptitude, ethical values, leadership qualities and lifelong learning in professional, academic and entrepreneurial careers.

PROGRAM OUTCOMES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO 1: Analyze, design, and optimize mechanical components, manufacturing systems, and production processes using CAD/CAM, simulation, and optimization tools.

PSO 2: Apply additive manufacturing, automation, robotics, AI, intelligent manufacturing, and CIM concepts for advanced manufacturing applications.

PSO 3: Evaluate and improve manufacturing processes, metrology & inspection systems, quality assurance practices, and production operations through data-driven and research-oriented approaches.

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, TEKKALI

(An Autonomous Institution)

M.Tech CourseStructure (AR 26)

COMPUTER INTEGRATED MANUFACTURING

M. Tech., (CIM) - I SEMESTER						
Semester	**Course Code**	**Subject**	**L**	**T**	**P**	**C**
I	26MCM1001	Advanced Computer Aided Design	4	0	0	4
	26MCM1002	Additive Manufacturing	4	0	0	4
	26MCM1003	Optimization Techniques	4	0	0	4
	Program Elective –I					
	26MCM1E11	Tool Design	3	0	0	3
	26MCM1E12	Machine Learning				
	Program Elective – II					
	26MCM1E21	Metrology and Computer Aided Inspection	3	0	0	3
	26MCM1E22	Design for Manufacturing and Assembly				
	26MCM1101	Additive Manufacturing Lab	0	0	4	2
	26MCM1102	Computer Aided Design and Manufacturing lab	0	0	4	2
	Audit Course - 1					
	26MAC1001	English for Research Paper Writing	2	0	0	0
	26MAC1002	Disaster Management				
	26MAC1003	Constitution of India				
	Total		**20**	**0**	**8**	**22**

M. Tech. (CIM) - II SEMESTER						
Semester	**Course Code**	**Course**	**L**	**T**	**P**	**C**
II	26MCM1004	Product Design and Value Engineering	4	0	0	4
	26MCM1005	Computer Integrated Manufacturing Systems	4	0	0	4
	26MCM1006	Intelligent Manufacturing	4	0	0	4
	Program Elective –III					
	26MCM1E31	Finite Element Analysis	3	0	0	3
	26MCM1E32	Automation in Advanced Manufacturing Systems				
	Program Elective –IV					
	26MCM1E41	Design of Robotic Systems	3	0	0	3
	26MCM1E42	Logistics and Supply Chain Management				
	26MCM1103	Simulation Lab	0	0	4	2
	26MCC1001	Research Methodology and IPR / Swayam 12-week MOOC course - RM & IPR	2	0	0	2
	Total		**20**	**0**	**4**	**22**

M. Tech. (CIM) - III SEMESTER						
Semester	**Subject Code**	**Subjects**	**L**	**T**	**P**	**C**
III	26MCM2I01	Internship/Industrial Training (8 weeks)	-	-	-	3
	26MCM2201	Technical Seminar	-	-	4	2
	26MCM2202	Comprehensive Viva	-	-	-	2
	26MCM2203	Dissertation Phase – I	0	0	20	10
Total			**0**	**0**	**24**	**17**
M. Tech (CIM) - IV SEMESTER						
Semester	**Subject Code**	**Subjects**	**L**	**T**	**P**	**C**
IV	26MCM2204	Dissertation Phase – II	0	0	32	16
Total			**0**	**0**	**32**	**16**

L –Lecture hours/Week; **T – Tutorial hours/Week;**

P – Practical hours/ Week; **C – Credits;**

ADVANCED COMPUTER AIDED DESIGN

Subject Code: 26MCM1001	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- To gain knowledge on computer aided graphics for designing 2D and 3D models.
- To explain 2D curves, 3D models, modeling methods and CAD file formats.
- To comprehend knowledge on reverse engineering concepts.

COURSE OUTCOMES

CO 1	Familiarize with graphics operations and various standards
CO 2	Develop proficiency in curve generation and interpolation techniques and construct, visualize 3D models from 2D drawings.
CO 3	Apply advanced geometric modeling techniques
CO 4	Prepare and manipulate CAD models
CO 5	Understand and apply reverse engineering concepts

SYLLABUS

UNIT-I

Graphics primitives: Primitive operations, The display-file interpreter, Display-file structure, Display-file algorithms.

Graphics Standards: Graphics and computing standards, data exchange standards, design database, interfacing design and drafting, mechanical assembly.

UNIT-II

Curves: Curve generation, Interpolation, B splines, Curved surface patches, Bezier curves, mathematical representation of space curves such as cubic splines, Bezier curves, B-spline and NURBS.

Three-dimension models:3D geometry, 3D primitives, 3D transformations, Parallel projection, Perspective projection, Isometric projections, Viewing parameters, Special projections. Hidden surfaces and lines: Back-face removal, Back-face algorithms, The Painter's algorithm, Warnock's algorithm, Franklin algorithm, Hidden-line methods.

UNIT-III

Geometric Modeling: Presentation of dimensioning / tolerances/symbols & annotation, Associatively, Parent child relationship, Parametric design, Programming techniques in

drafting/ modeling/analysis, Concept of computer animation, Properties calculation, Surface design, Surface theory, Surface analysis, Fundamentals of solid modeling, Different approaches of creating an assembly.

UNIT-IV

CAD models: Model preparation, Data interfacing formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing.

UNIT-V

Reverse Engineering: History of Reverse Engineering, Concept of reverse engineering, Importance and various methods of RE, Scope and tasks of RE, Preserving and preparation for the four stage process, Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation, Equipment Involved in the Reverse Engineering technique, Integrating formal and structured methods in reverse engineering, Integrating reverse engineering, reuse and specification tool environments to Rapid Prototyping.

TEXT BOOKS

1. Zhigang Xiang, Roy A. Plastock, 'Computer Graphics', 2nd Edition , McGraw Hill Education (India) Private Limited
2. Computer Graphics - A Programming Approach by Steven Harrington, McGraw-Hill International Edition, 1987.

REFERENCE BOOKS

- Schaum's Outline of Theory and Problems of Computer Graphics by Roy A. Plastock and Gordon Kalley, McGraw-Hill Companies, Inc., 1986.
- Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
- Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991

AR-26 / M.TECH. / CIM **I Year I Semester**

ADDITIVE MANUFACTURING

Subject Code: 26MCM1002	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- Explore and analyze the evolution and fundamentals of rapid prototyping
- Develop expertise in various rapid prototyping techniques
- Assess and manage post-processing and data format challenges

COURSE OUTCOMES

CO 1	Understand the fundamentals and historical development of rapid prototyping
CO 2	Gain knowledge of liquid-based rapid prototyping systems
CO 3	Gain proficiency in wire additive manufacturing techniques
CO 4	Analyze case studies involving powder-based rapid prototyping
CO 5	Understand and address issues related to rapid prototyping data formats, post-processing concerns

SYLLABUS

UNIT-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, RP Applications.

UNIT-II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-III

Sheet Additive Manufacturing: Classification, Cubic Technologies' LOM, Kira's Paper Lamination Technology, CAM-LEM's CL: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Ultrasonic Consolidation: Fundamentals, Process Parameters, Process Modeling.

Wire Additive Manufacturing: Classification, Fused Deposition Modeling (FDM): Models and specifications, Machine Architecture, feeding & pitch mechanism, critical forces, melt properties, Liquefier dynamics, Die swelling and bead cooling, Bead deposition, spreading and bonding, Surface Roughness, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-IV

Powder Based Rapid Prototyping Systems: Classification, Working Principle, Laser cladding: Principle, Powder–Handling System, and Powder –Delivery System: Design Consideration, Powder–Feed AM Process Modeling, and Applications.

Binder based AM: Classification, Working Principle: Sub-systems, 3D Printing: Z Corp's 3D Printer, Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-V

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

Post-processing concerns: Post-processing needs, defects in RM parts, issue in metal RM parts, Support materials removal, Surface texture improvements

TEXT BOOKS

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2015.
2. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.

REFERENCE BOOKS

- Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.
- Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
- Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2000

AR-26 / M.TECH. / CIM **I Year I Semester**

OPTIMIZATION TECHNIQUES

Subject Code: 26MCM1003	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- Understand Linear Programming concepts and develop skills to formulate and solve LPPs using graphical and simplex methods, including handling artificial variables.
- Analyze nonlinear programming problems and apply Kuhn–Tucker optimality conditions and minimum cost flow concepts for constrained optimization.
- Analyze and solve geometric programming problems, including both unconstrained and constrained cases.
- Use dynamic programming techniques to solve complex multistage decision-making problems using forward and backward recursion

COURSE OUTCOMES

CO 1	Formulate, solve linear programming problem using graphical and simplex method along with its Big-M.
CO 2	Apply nonlinear programming techniques and Kuhn–Tucker optimality conditions to solve constrained optimization problems and minimum cost flow problems
CO 3	Calculate optimum solution of unconstrained and constrained geometric programming problems.
CO 4	Perform multi-stage decision processes using dynamic programming including applications like inventory, allocation, replacement.
CO 5	Solve integer programming optimization problems using Gomory's cutting plane and branch and bound method

SYLLABUS

UNIT-I

Linear Programming: Introduction to linear programming problem formulation, Graphicalsolution, Simplex method, Artificial variables techniques

UNIT-II

Non-linear Programming Problems: Non-linear programming problem - Kuhn-Tucker conditions and Lagrange multiplier method.

UNIT-III

Geometric Programming: Polynomials – arithmetic - geometric inequality– unconstrained

G.P, constrained G.P

UNIT-IV

Dynamic programming: Introduction to Dynamic Programming, Basic components of Bellman‘s Principle of optimality, Forward and Backward Recursive approach, Applications of DP-cargo loading.

UNIT-V

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

TEXT BOOKS

1. Optimization theory & Applications / S.S.Rao / New Age International.

2. Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications

REFERENCE BOOKS

- Engineering Optimization Theory and Practice, Fourth Edition, Singiresu S. Rao.

TOOL DESIGN

Subject Code: 26MCM1E11	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- To classify and understand various types of cutting tools, including their materials
- To gain knowledge on designing of various cutting tools
- To gain knowledge on designing of jigs and fixtures
- To gain knowledge in designing tools for super-finishing processes

COURSE OUTCOMES

CO 1	Explain the classification of cutting tools and tool parameters like tool material, tool life etc.
CO 2	Design single and multi-point cutting tools.
CO 3	Design of broaches and super-finishing processes.
CO 4	Design of drills and reamers.
CO 5	Design of press tools, jigs and fixtures for various machine tool operations

SYLLABUS

UNIT-I

Introduction to cutting tool features: Classification and coding of cutting tools, carbide tools, and coated tools. Cutting tool life, tool failure, types of tool failures, cutting tool fluids, and tool materials.

UNIT-II

Design of Single-Point Cutting Tools: Form Tools, Design of flat and circular form tools, Tool holding methods.

Design of Multi-Point Cutting Tools: Milling Cutters: Major types, design and manufacturing of peripheral, end and face milling cutters, forces and power estimation, grinding of milling cutters.

UNIT-III

Broaches: Pull and Push types. Internal and External broaches, geometry and design and manufacturing of pull type and push type broaches.

Super-finishing Processes: Honing, Lapping Burnishing, Ballizing, Polishing.

UNIT-IV

Drills: Twist drill geometry, Design and manufacturing of twist drill – Effect of variation of different angles on torque and thrust forces – Types and design of shanks – Sharpening of twist drill, Design and manufacture of twist drills.

Reamers: Types, Geometry, Reaming allowance, Tolerance disposition.

UNIT-V

Design of Press Tools: Die set elements – Design of die set for simple components in Blanking, Piercing, Bending, Drawing, Forging and Spinning.

Jigs & Fixtures: Design principles and constructional features – Locating methods associated with flat, cylindrical, internal and external surfaces, Types of locating pins, Requirements and choice of locating systems

TEXT BOOKS

1. Tool Design, Cyril Donaldson, V. C. Goold, 4th edition, Tata McGraw Hill Pub, 2012.
2. Surender Keshav & Umesh Chandra, *Production Engineering* Design (Tool Design), Satya Prakashan, New Delhi-1994.

REFERENCE BOOKS

- Metal Cutting Theory and practice, Amitabha Bhattacharya, Inyong Ham, ASTME Pub
- Design of Cutting Tools, Rodin, Mir Publications, Moscow.
- Fundamentals of Tool Design, Sixth Edition, Society of Manufacturing Engineers Dearborn, Michigan

AR-26 / M.TECH. / CIM **I Year I Semester**

MACHINE LEARNING

Subject Code: 26MCM1E12	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To understand and articulate the fundamental concepts of machine learning
- Develop a comprehensive understanding of machine learning techniques and their applications
- Gain proficiency in implementing and evaluating machine learning models and theoretical concepts
- To explore and implement advanced learning methods, including inductive logic programming and unsupervised learning,

COURSE OUTCOMES

CO 1	Explain fundamental machine learning concepts, learning paradigms, and hypothesis representation.
CO 2	Analyze and implement concept learning algorithms including Boolean representations and version space methods.
CO 3	Design and evaluate neural networks and linear learning models.
CO 4	Apply statistical learning techniques, decision trees, and model evaluation strategies.
CO 5	Evaluate advanced learning paradigms including inductive logic programming, computational learning theory, and unsupervised learning methods.

SYLLABUS

UNIT-I

Introduction: Preliminaries, what is machine learning; varieties of machine learning(supervised, unsupervised, reinforcement), learning input/output functions, sample applications, Hypothesis space and generalization.

UNIT-II

Boolean functions and their classes, CNF, DNF, decision lists. Version spaces and version graphs, search of a version space, candidate elimination algorithm, Inductive bias.

UNIT-III

Threshold logic units, Linear machines, Networks of threshold units, Neural networks architecture basics, Neural networks vs knowledge-based systems, Bias–variance

considerations in linear models.

UNIT-IV

Statistical learning background and general method, Learning belief networks, Nearest neighbor methods, Decision trees (univariate trees), Network equivalent of decision trees, Overfitting and model evaluation techniques.

UNIT-V

Inductive Logic Programming, introducing recursive programs, inductive logic programming vs decision tree induction, Computational learning theory, fundamental theorem, Vapnik-Chernonenkis dimension, linear dichotomies and capacity.

Unsupervised learning, clustering methods based on Euclidean distance and probabilities, hierarchical clustering methods. Introduction to reinforcement and explanation-based learning.

TEXT BOOKS

1. **"Introduction to Machine Learning"**; by Nils J. Nilsson; *Publisher not specified*; **1st Edition**; **1998**.
2. **"Machine Learning For Dummies"**; by Judith Hurwitz, Daniel Kirsch, *et al.*; IBM Limited Edition; **1st Edition**; **2015**.

REFERENCE BOOKS

- **"Introduction to Machine Learning with Python: A Guide for Data Scientists"**; by Andreas C. Müller, Sarah Guido; O'Reilly Media; **1st Edition**; **2016**.
- **"Pattern Recognition and Machine Learning"**; by Christopher M. Bishop; Springer; **1st Edition**; **2006**.
- **"Understanding Machine Learning: From Theory to Algorithms"**; by Shai Shalev-Shwartz, Shai Ben-David; Cambridge University Press; **1st Edition**; **2014**.

AR-26 / M.TECH. / CIM **I Year I Semester**

METROLOGY AND COMPUTER AIDED INSPECTION

Subject Code: 26MCM1E21	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Master fundamental measurement concepts and surface texture analysis
- Comprehend and utilize advanced measurement techniques and instruments
- Apply Nano-metrology principles to cutting-edge measurement challenges

COURSE OUTCOMES

CO 1	Understand fundamental measurement concepts
CO 2	Understand surface texture definitions and types
CO 3	Comprehend the principles of light interference and interferometry
CO 4	Utilize advanced measuring instruments, ray-basedand advanced imaging techniques
CO 5	Understand and apply the principles of nano-metrology

SYLLABUS

UNIT-I

Definition, Standards of measurement, Errors in measurement, Interchangeability and Selective assembly, Dimensional and Form tolerances – Accuracy and Precision, Calibration of instruments, Linear measurement, Angular measurement

UNIT-II

Definitions and Types of Surface Texture, Surface Roughness Measurement Methods, Comparison, Profilometer, 3D Surface Roughness Measurement, Instruments

UNIT-III

Interferometry: Introduction, Principles of light interference, Interferometers, Measurement and Calibration, Laser Interferometry, Tool Makers Microscope

UNIT-IV

CMM, Constructional features – Types – Applications of CMM, Laser Micrometer, Laser Scanning gauge, Non contact and in-process inspection.

Vision system, Overview of Computer imaging systems, Image Analysis

Ray based scanning techniques, X-ray technique, CT technique

UNIT-V

Nanometrology – Introduction – Principles – Nanometer metrology systems – Methods of measuring length and surfaces to nano scale result with interferometers and other devices.

TEXT BOOKS

1. Metrology for engineers By GNGalyer FW and CRSHOTBOLT, ELBS, 1990.
2. Industrial Metrology By Graham TSmith, Springer, 2002.
3. White house, D. J, "Handbook of Surface & Nanometrology", The institute of Physics,London, 1994.

REFERENCE BOOKS

- ASTE Handbook of Industries Metrology, Prentice Hall of India Ltd., 1992.
- Image Processing, Analysis, and Machine Vision By Milan Sonka, Vaclav Hlavac and Roger Boyle, Cengage-Engineering; 3 Ed., 2007

DESIGN FOR MANUFACTURING AND ASSEMBLY

Subject Code: 26MCM1E22	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Integrate material and process selection for component design
- Apply design considerations for manufacturing processes
- Develop and implement assembly systems and methodologies

COURSE OUTCOMES

CO 1	Understand material selection and relate it to process selection for a component
CO 2	Explain design considerations for machining and casting processes
CO 3	Understand thermal stresses in welding and post-treatment of weld joints, and apply design guidelines for extruded and plastic components.
CO 4	Understand automatic assembly transfer systems
CO 5	Design systematic DFA methodology for manual assembly

SYLLABUS

UNIT-I

Design Philosophy for Manufacturability and Production Processes: Steps in the design process, General design rules for manufacturability, Basic principles of designing for economical production, Creativity and innovation in design.

Materials: Material selection for design, Recent developments in material technology, Criteria for material selection, Interrelationship between material and process selection, Process selection charts for material and design compatibility.

UNIT-II

Machining Process: Overview of various machining processes - general design rules for machining - Dimensional tolerance and surface roughness - Design for machining - Ease - Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Metal Casting: Appraisal of various casting processes, selection of casting process,- general design considerations for casting-casting tolerances-use of solidification simulation in casting design - product design rules for sand casting.

UNIT-III

Metal Joining: Appraisal of various welding processes, Factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints- design of brazed joints. Forging - Design factors for Forging - Closed dies forging design - parting lines of dies drop forging die design-general design recommendations.

Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking.

Plastics: Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

UNIT-IV

Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.

Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

UNIT-V

Design of Manual Assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

TEXT BOOKS

1. **"Product Design for Manufacture and Assembly"**; by Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight; CRC Press; 3rd Edition; 2010-2011.
2. **"Product Design and Development"**; by Karl T. Ulrich, Steven D. Eppinger; McGraw-Hill Education; 7th Edition; 2020.

REFERENCE BOOKS

- **"Engineering Design: A Materials & Processing Approach"**; by George E. Dieter; McGraw-Hill Education; 6th Edition; 2022.
- **"Handbook of Product Design"**; by Geoffrey Boothroyd; Marcel Dekker; Original Edition; 1990.

ADDITIVE MANUFACTURING LAB

Subject Code: 26MCM1101	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- Master data translation and additive manufacturing technologies
- Design, manufacture, and optimize additive manufacturing parts and assemblies
- Develop and test advanced additive manufacturing materials and techniques

COURSE OUTCOMES

CO 1	Understand and utilize data translation and export design functionalities
CO 2	Demonstrate and explain the use of various additive manufacturing machines
CO 3	Design and manufacture simple parts and assemblies for additive manufacturing
CO 4	Apply slicing software for part development and process optimization
CO 5	Develop and test composite solid filaments for extrusion additive manufacturing

LIST OF EXPERIMENTS

1. Learn Data Translation – Built in translation facility to export design
2. Demonstrate various machines used in AM (Physical &/or video explaining processes and functions.
3. Design a simple part for AM to understand product design.
4. Design and make a simple assembly/ sub assemble model to create simple 3D utility item by assembling different sub-assembly.
5. Checkout the various orientation, various settings of the part development using slicing software
6. Analyze and apply different process of algorithm for slicing/ supports/ layers/ orientation etc.
7. Develop a composite solid filament and to determine optimal condition of internal mixture
8. Develop a composite solid filament and to determine optimal condition of wire extruder

9. Test the developed filament fluidic properties via Melt Flow Index test rig
10. Print polymer composite parts with cloud based slicing software
11. Manufacture simple item viz., Bracket/ Lever, Clamp, Spur Gear, threaded components etc. by extrusion additive manufacturing (FFF Technology).
12. Design for Additive manufacturing (DFAM).
13. Scan a job at various angles; club/ combine scanned data or images; process the scanned data to develop mesh file (.STL) to create a parametric model
14. Finish job by different post processing techniques and Quality Checks

TEXT BOOKS

1. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

COMPUTER AIDED DESIGN AND MANUFACTURING LAB

Subject Code: 26MCM1102	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- To provide knowledge of modeling tools for creating solid and surface models.
- To provide knowledge on different CAD software.
- To simulate the tool path of cutting tool on the work piece in computer aided manufacturing.
- To generate NC program on verification of tool path for simple components in turning and milling

COURSE OUTCOMES

CO 1	Proficiency in 3D part modeling techniques
CO 2	Conversion of 3D models to 2D drawings
CO 3	Modeling and assembling machine elements
CO 4	Development of assembly drawings and bills of materials
CO 5	Tool path simulation and NC code generation

LIST OF EXPERIMENTS

A) MODELING:

1. 3D Part modelling– Extrusion, Cut/hole, Sweep, Draft, Loft, Blend and Rib.

2. Editing– Move, Pattern, Mirror, Round and Chamfer

3. Conversion of 3D solid model to 2D drawing- Different views, Sections, Isometric view and Dimensioning

4. 3D modelling of machine elements like Flanged coupling and Screw jack.

6. Assembly Drawing (Using Application Packages) Parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages.

7. Suggested Assemblies: (any 3) Shaft couplings– Plummer block– Screw jack– Lathe Tailstock– Universal Joint– Machine Vice– Stuffing box– Safety Valves- Non-return valves– Connecting rod– Piston and crank shaft– Multi plate clutch– Preparation of Bill of materials

and tolerance data sheet

B) TOOL PATH SIMULATION ANDNCCODE GENERATION:

1. NC Code (G-codes & M-codes) generation using CAD / CAM software- Post processing for standard CNC Controls for any of FANUC, Siemensetc.

Note: Use any of following software: CATIA, UNIGRAPHICS NX, SOLIDWORKS, SOLIDEDGE

AR-26 / M.TECH. / CIM **I Year I Semester**

ENGLISH FOR RESEARCH PAPER WRITING

Subject Code: 26MAC1001	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- To develop students' ability to plan and organize academic writing by mastering word order, sentence structure, paragraph development, conciseness, and techniques for avoiding ambiguity and redundancy.
- To enable learners to present ideas clearly and responsibly through skills such as clarifying agency (who did what), highlighting findings, using hedging and criticism appropriately, and avoiding plagiarism through effective paraphrasing.
- To train students in the structure and components of a research paper by understanding and producing well-organized abstracts, introductions, literature reviews, methods, results, discussions, and conclusions.
- To enhance students' competence in writing key academic sections—including titles, abstracts, introductions, and literature reviews—using appropriate academic style, coherence, and logical progression.
- To equip learners with practical skills for drafting, revising, and finalizing research papers by applying section-specific writing strategies and conducting a thorough final check for clarity, accuracy, and academic integrity.

COURSE OUTCOMES

CO 1	**Students will be able to plan and organize academic texts effectively** by applying correct word order, clear sentence and paragraph structure, and techniques for conciseness while avoiding ambiguity and redundancy.
CO 2	**Students will be able to present information clearly and ethically** by clarifying agency (who did what), highlighting key findings, using appropriate hedging and criticism, and avoiding plagiarism through accurate paraphrasing.
CO 3	**Students will be able to write and evaluate major sections of a research paper** such as literature reviews, methods, results, discussions, conclusions, and perform a final check for coherence and accuracy.
CO 4	**Students will be able to construct effective titles, abstracts, and introductions** and develop logically organized reviews of literature using accepted academic writing conventions.
CO 5	**Students will be able to apply section-specific writing skills** to produce well-structured methods, results, discussion, and conclusion sections that meet academic and research communication standards.

SYLLABUS

UNIT-I

Planning and preparation, Word order, Breaking up long sentences, Structuring paragraphs and sentences. Being concise and removing redundancy, Avoiding ambiguity and vagueness.

UNIT-II

Clarifying who did what, Highlighting findings. Hedging and criticizing. Paraphrasing and plagiarism, Sections of a paper, Abstracts, Introduction.

UNIT-III

Review of the Literature. Methods, Results, Discussion, Conclusions, Final check.

UNIT-IV

Key skills needed when writing a title. An abstract, An introduction and a review of the Literature.

UNIT-V

Skills needed when writing methods, Results, Discussions and Conclusion.

TEXT BOOKS

1. Goldbort R (2006). Writing for Science. Yale University Press.
2. Day R (2006). How to Write and Publish a Scientific Paper. Cambridge University Press.
3. Highman N (1998). Handbook of Writing for the Mathematical Sciences. SIAM.

DISASTER MANAGEMENT

Subject Code: 26MAC1002	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- To provide basic concepts and terminologies related to hazards and disasters
- To highlight the critical importance and role of disaster management in the contemporary world.
- To enhance awareness of institutional processes, policies, and management strategies used to mitigate disaster impacts.
- To analyze the various dimensions of vulnerability and their contribution to disaster risk.
- To equip knowledge regarding emergency management for manmade and technological threats.

COURSE OUTCOMES

CO 1	Define and classify different types of disasters and distinguish them from hazards.
CO 2	Evaluate the nature of vulnerability and assess the impacts of disasters on different communities.
CO 3	Explain the components of the Disaster Management Cycle, including mitigation, preparedness, response, and recovery.
CO 4	Discuss the institutional frameworks and legislations available for disaster risk management at national and international level.
CO 5	Identify specific threats related to industrial accidents and security, and understand the necessary emergency response mechanisms.

SYLLABUS

UNIT-I

Introduction and Basic Concepts: Understanding Fundamental Concepts: Definitions of Hazards and Disasters. Classification: Disaster types and causes including Geophysical, Hydrological, Meteorological, Biological, Atmospheric, and Human-made. Distinguishing between natural hazards and manmade disasters

UNIT-II

Dimensions of Disasters and Vulnerability: Global Trends: Analysis of global trends in disasters. Impact analysis: Physical, Social, Economic, Political, Environmental, and Psychosocial impacts of disasters. Understanding Vulnerability: Defining and analyzing Physical Vulnerability, Economic Vulnerability, and Social Vulnerability

UNIT-III

The Disaster Management Cycle and Risk Reduction: Detailed study of the components of DM Cycle: Response and recovery, Risk assessment, Mitigation and prevention, Preparedness planning, Prediction and warning. Disaster Risk Reduction (DRR): Concepts of DRR and Community based disaster risk reduction strategies.

UNIT-IV

Institutional Frameworks and Initiatives: National Context: Disaster Risk Management in India; related policies, plans, programs, and legislation. Global Context: International strategies for disaster reduction and other global initiatives. Agencies: Role of agencies NIDM, NDRF.

UNIT-V

Emergency Management and Emerging Threats: Technological and Industrial Disasters: Explosions, Industrial accidents, Nuclear, Transport, and Mining accidents. Environmental Emergencies: Spills (Oil and Hazardous material). Security Threats: Bomb threats, terrorist attacks, stampedes, and conflict situations.

TEXT BOOKS

1. Sharma, S.C., Disaster Management, Khanna Book Publishing. Latest Edition
2. Singh, R. B. (ed.), Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi. Latest Edition
3. Modh, S., Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi. Latest Edition

REFERENCES BOOKS

- Carter, N., Disaster Management: A Disaster Management Handbook, Asian Development Bank, Manila. Latest Edition
- Clements, B. W., Disasters and Public Health: Planning and Response, Elsevier Inc. Latest Edition
- Dunkan, K., and Brebbia, C. A. (Eds.), Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK. Latest Edition
- Ramkumar, Mu, Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi. Latest Edition

CONSTITUTION OF INDIA

Subject Code: 26MAC1003	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- To provide students with a comprehensive understanding of the historical background and salient features of the Indian Constitution, including Fundamental Rights, Duties, and Directive Principles of State Policy.
- To familiarize learners with the structure and functioning of local self-government institutions and the importance of grassroots democracy in India.
- To develop awareness of the parliamentary system of government in India, including the roles and powers of the President, Prime Minister, Cabinet, and Judiciary.
- To explain the nature of Indian federalism and the legislative procedures and privileges of Union and State legislatures.
- To enable students to understand the role and functioning of constitutional and statutory bodies such as parliamentary committees, Election Commission, CAG, Finance Commission, NITI Aayog, and political parties.

COURSE OUTCOMES

CO 1	Students will be able to **explain the origin, structure, and key features of the Indian Constitution,** including Fundamental Rights, Fundamental Duties, and Directive Principles.
CO 2	Students will be able to **describe the organization and functions of local administration,** including Panchayati Raj Institutions and municipal bodies, and appreciate the value of participatory democracy.
CO 3	Students will be able to **analyze the working of the parliamentary system** and the emergency provisions, and understand the relationship between the executive, legislature, and judiciary.
CO 4	Students will be able to **interpret the principles of Indian federalism** and explain Union–State relations and the legislative process in Parliament and State Legislatures.
CO 5	Students will be able to **evaluate the role of constitutional and non-constitutionalbodies**and recognize their contribution to democratic governance and accountability in India.

SYLLABUS

UNIT-I

Introduction: Historical perspective of the constitution of India -Salient features of The Indian Constitution-Features: Fundamental Rights (Article 12 to 35), Duties (31 A-1976

emergency) and Directive principles (Article 30 to 51) of State Policy - Articles 14 to 18 Articles 19-Article 21-Amendment Procedure of The Indian Constitution: 42nd amendment (Mini Constitution)-44th amendment (1978-Janatha Govt.)

UNIT-II

Local Administration: District's administration head: Role and Importance, Municipalities Introduction, Mayer and role of elected representative, CEO of municipal corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of elected and appointed officials, Importance of grass root democracy.

UNIT-III

Parliamentary form of Govt. In India: President of India- Emergency provisions- National Emergency Article 352 President Rules- Article 356 Financial Emergency- Article 360 Prime Minister and Cabinet-Supreme Court of India (Indian Judiciary)

UNIT-IV

Indian Federalism: Union State relations, Legislative, Administrative and Financial relations. Lok Sabha, Rajya Sabha, Vidhan Sabha & Vidhan Parishad-Composition, Speaker, Chairman, Privileges, Legislative procedure.

UNIT-V

Parliamentary Committees: Public Accounts Committee- Estimates Committee- Committee on Public Undertakings- Election commission of India (Article -324) -Comptroller and Auditor General (CAG) of India (Article 148 to 150) Finance Commission (Article-280)- Neethi Aayog (Planning Commission) and Political Parties.

TEXT BOOKS

1. DD Basu-Indian Constitution
2. Dr. D. Surannaida - Indian Political System.
3. Madhav Khosla- The Indian Constitution

REFERENCES BOOKS

- The Constitution of India. 1950 (Bare Act), Government Publication
- M. P. Jain, Indian Constitution Law, 7th Edn, Lexis Nexis, 2014

PRODUCT DESIGN AND VALUE ENGINEERING

Subject Code: 26MCM1004	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- Analyze product specifications and life cycles to align design with profit considerations.
- Apply Value Engineering (VE) and Functional Analysis to eliminate unnecessary costs.
- Evaluate engineering materials and process capabilities for robust product performance.
- Implement DFM/DFA guidelines for casting, molding, machining, and advanced joining.
- Integrate Ergonomics, Sustainability (DfE), and Rapid Prototyping into the final design.

COURSE OUTCOMES

CO 1	Formulate product strategies based on life-cycle analysis and profit considerations.
CO 2	Execute a Value Engineering Job Plan (VEJP) using Functional Analysis (FAST).
CO 3	Select optimal engineering materials and evaluate process capabilities for design
CO 4	Apply DFM/DFA guidelines to casting, molding, machining, and joining processes.
CO 5	Implement Rapid Prototyping, Ergonomics, and DfE in final product architecture.

SYLLABUS

UNIT-I: Product Strategy &Policy

Introduction: Course overview, Product Life-Cycle (PLC), and Product Policy of an organization.**Market Alignment:** Selection of a profitable product; Product Design Process and Product Analysis.**Economics:** Profit considerations and the morphology of design.

UNIT-II: Value Engineering & Functional Analysis

VE Fundamentals: History, concepts, and definitions; Value Engineering vs. Cost Cutting. **The VE Job Plan (VEJP):** Problem identification, selection, and Creative Thinking; Behavioral roadblocks. **Functional Analysis:** Anatomy of function; Primary, secondary, and tertiary functions; Functional Analysis System Technique (FAST).**Applications:** Function-Cost relationships and Value Engineering Case Studies.

UNIT-III :Materials, Processes & Robust Design

Material Selection: Engineering materials, properties, and systematic selection criteria. **Process Capabilities:** Introduction to manufacturing processes; Advantages, limitations, and Process Capabilities (Basics & Selection). **Design Tools:** Quality Function Deployment **(QFD)**, CAD, Robust Design, and Design for X (DfX).

UNIT-IV :Design for Manufacture & Assembly

DFM Guidelines: Specific guidelines for Sand Casting, Die Casting, Injection Molding,

Extrusion, Sheet Metal Working, Machining, and Powder Metallurgy.

DFA Guidelines: Product design for manual assembly. **Joining & Assembly:** Guidelines for adhesive joining, Mechanical Fasteners, Welding, Brazing, and Soldering. **Advanced Joining:** Induction, Ultrasonic, and Vibration welding for plastics.

UNIT-V: Human Factors, Prototyping & Environment

User-Centric Design: Ergonomics and Aesthetics in product design. **Sustainability: Design for Environment (DfE)**: Steps and impact. **Advanced Tools:** Rapid Prototyping (RP): Needs and working principles of SLA, LOM, and SLS. **Synthesis:** Product Architecture and the Manufacturing Perspective in final design.

TEXT BOOKS

1. Boothroyd, G., Dewhurst, P., & Knight, W. A. (2010). Product design for manufacture and assembly (3rd ed.). CRC Press.
2. Chitale, A. K., & Gupta, R. C. (2013). Product design and manufacturing (6th ed.). PHI Learning.

REFERENCE BOOKS

- Bralla, J. G. (1998). Design for manufacturability handbook (2nd ed.). McGraw-Hill.
- Shan, H. S. (2017). Manufacturing processes: Casting, forming and welding. Cambridge University Press.
- Zimmerman, L. W., & Hart, G. D. (1999). Value engineering. CBS Publishers & Distributors.

COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Subject Code: 26MCM1005	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- Comprehend fundamental concepts of Computer-Integrated Manufacturing (CIM)
- Plan and schedule manufacturing processes using CIM principles
- Integrate factory floor functions with computer-assisted applications

COURSE OUTCOMES

CO 1	Analyze the architecture, functional elements, and implementation strategies of Computer Integrated Manufacturing systems.
CO 2	Design and evaluate computer-integrated production planning and scheduling systems including MRP, ERP, and JIT frameworks.
CO 3	Develop integrated manufacturing information and database systems for seamless data communication and shop-floor integration.
CO 4	Integrate flexible manufacturing systems and computer-controlled automation technologies within enterprise-level CIM environments.
CO 5	Apply intelligent manufacturing and enterprise integration strategies to optimize computer-integrated production systems.

SYLLABUS

UNIT-I

Fundamentals of Computer Integrated Manufacturing Systems: Manufacturing enterprise challenges, World-class manufacturing criteria, CIM definition and benefits, Implementation steps of CIM, Manufacturing system classification, Organizational structure of manufacturing systems, Functional areas of CIM (CAD, CAPP, CAM, CAQC, ASRS), Introduction to Industry 4.0 concepts in CIM environments.

UNIT-II

Computer-Integrated Production Planning and Control: Aggregate Production Planning (APP), Master Production Scheduling (MPS), Material Requirement Planning (MRP), Capacity Requirement Planning (CRP), Manufacturing Resource Planning (MRP-II), Enterprise Resource Planning (ERP), Just-In-Time (JIT) systems, Kanban systems, Computer-based production control and monitoring.

UNIT-III

Manufacturing Information Systems and Digital Integration: Manufacturing data models, Product data management (PDM), Manufacturing database architecture, Database management systems in CIM, Data communication technologies in manufacturing, Shop-floor data acquisition systems, Automated identification technologies (RFID, Barcode systems), Interoperability between CAD–CAPP–CAM systems, Digital thread in manufacturing enterprises, Cyber-enabled production data management.Data Communication Technologies, Database Management Technologies, Automated Data Collection in Shop Floor.

UNIT-IV

Flexible and Computer-Controlled Manufacturing Systems: Flexible Manufacturing Systems (FMS), Components of FMS, Workstation configurations, Material handling and storage systems in FMS, Automated Guided Vehicles (AGVs), Planning and performance evaluation of FMS, Computer control of manufacturing systems, Numerical Control (NC), Computer Numerical Control (CNC), Direct Numerical Control (DNC), Adaptive control with constraints, Adaptive control with optimization, Integration of FMS with enterprise-level CIM systems.

UNIT-V

Intelligent and Enterprise-Level Computer Integrated Manufacturing: Lean manufacturing principles in CIM, World-class manufacturing systems, Agent-based manufacturing systems, Enterprise integration and digital enterprise concepts, Reengineering in manufacturing systems, Computer-enabled decision support systems, Data-driven production monitoring and control, Smart factory integration concepts, Enterprise resource integration in CIM environments, Future trends in computer-integrated manufacturing systems.

TEXT BOOKS

1. **"Automation, Production Systems, and Computer-Integrated Manufacturing"**; by Mikell P. Groover; Pearson; 5th Edition; 2015.
2. **"Computer-Integrated Manufacturing"**; by James A. Rehg, Henry W. Kraebber; Pearson; 3rd Edition; 2005.
3. **"Flexible Manufacturing Systems"**; by H.K. Shivanand, M.M. Benal, V. Koti; New Age International; 2006.

REFERENCE BOOKS

- **"Manufacturing Planning and Control for Supply Chain Management"**; by F. Robert Jacobs, William Berry, D. Clay Whybark, Thomas Vollmann; McGraw Hill; 6th Edition; 2011.
- **"Manufacturing Systems Modeling and Analysis"**; by Guy L. Curry, Richard M. Feldman; Springer; 2nd Edition; 2011.
- **"Principles of Computer Integrated Manufacturing"**; by S. K. Vajpayee; PHI Learning Pvt. Ltd., New Delhi; **1st Edition; 1998**.

INTELLIGENT MANUFACTURING

Subject Code: 26MCM1006	L	T	P	C
	4	0	0	4

COURSE OBJECTIVES

- Analyze the structure and functional areas of cim systems
- Implement machine learning and automated process planning in manufacturing
- Design and utilize group technology models and knowledge-based systems

COURSE OUTCOMES

CO 1	Understand the structure and functional areas of CIM systems
CO 2	Comprehend the components and functions of knowledge-based systems
CO 3	Apply machine learning concepts in manufacturing
CO 4	Implement automated process planning and expert systems
CO 5	Utilize group technology models and algorithms to design and analyze knowledge-based systems in manufacturing

SYLLABUS

UNIT-I

Computer Integrated Manufacturing Systems: Overview of CIM Systems, Advantages of CIM, Manufacturing Communication Systems (MAP/TOP, OSI Model, Data Redundancy), Intelligent Manufacturing System Components and Data Flow, Introduction to Industry 4.0, Cyber-Physical Systems (CPS), IoT, Digital Twins.

UNIT-II

Knowledge Based Systems: Knowledge Representation, Inference Engine, Knowledge Acquisition, **AI Techniques** in Knowledge-Based Systems, Machine Learning, Natural Language Processing (NLP), Case-Based Reasoning (CBR).

UNIT-III

Artificial Intelligence in Manufacturing: Overview of Artificial Intelligence and Neural Networks (Biological Neuron, Artificial Neuron), Applications in Manufacturing: Predictive Maintenance, Production Optimization, AI-Driven Decision Making, Reinforcement Learning for process optimization in automated manufacturing.

UNIT-IV

Automated Process Planning: Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based

System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT-V

Knowledge Based Group Technology: Visual Method, Coding Method, Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost-Based Method, Cluster Identification Method, Extended CI Method, AI in Group Technology: Knowledge-Based Systems for Group Technology (KBSCIT), Clustering Algorithms: K-means, DBSCAN, Optimization of part classification and resource allocation, AI integration in CIM for decision-making, part classification and its applications in automated manufacturing

TEXT BOOKS

1. **"Intelligent Manufacturing Systems"**; by Andrew Kusiak; Prentice Hall International; **1st Edition**; **1990**.
2. **"Smart Manufacturing: Concepts and Methods"**; by Masoud Soroush, Zhiqiang Ge, Biao Huang; Elsevier Science Publishing Co. Inc.; **1st Edition**; **2020**.
3. **"Automation, Production Systems and Computer Integrated Manufacturing"**; by Mikell P. Groover; Pearson/PHI; **5th Edition**; **2015**.

REFERENCE BOOKS

- **"Intelligent Manufacturing: Methods and Practices"**; by Zude Zhou, Shane (Shengquan) Xie, Dejun Chen; Springer/Elsevier; **1st Edition**; **2016**.
- **"Neural Networks in Computer Intelligence"**; by Li Min Fu; Tata McGraw-Hill; **1st Edition**; **2003**.
- **"Neural Networks: Principles, Applications and Programming"**; by James A. Freeman, David M. Skapura; Pearson Education; **1st Edition**; **2004**.
- **"Computational Intelligence in Manufacturing Handbook"**; edited by Jun Wang, Andrew Kusiak; CRC Press; **1st Edition**; **2000**.

FINITE ELEMENT ANALYSIS

Subject Code: 26MCM1E31	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend the fundamental principles of the finite element method (FEM)
- Apply FEM to solve 1D structural and thermal problems
- Extend FEM formulation to 2D and 3D problems

COURSE OUTCOMES

CO 1	Understand the fundamentals of structural analysis using FEM, including linear elastic mechanics, virtual displacements, and beam element analysis.
CO 2	Apply FEM to solve 2-D problems, considering plane stress, plane strain conditions, and using triangular and quadrilateral elements.
CO 3	Implement iso-parametric formulation, shape functions, and numerical integration techniques for 2-D FEM modeling and analysis.
CO 4	Analyze and formulate FEM for 3-D axisymmetric solids and the bending of flat plates using Kirchhoff's theory and boundary conditions.
CO 5	Apply FEM to advanced 3-D problems, including discrete Kirchhoff's elements, plate bending, dynamic analysis, and elastic stability in frames and plates.

SYLLABUS

UNIT-I

1-D Problems: Introduction to structural analysis and FEM, Introduction to approximate solutions and FEM, Principles of linear elastic mechanics, principles of virtual displacements and minimum potential energy, Rayleigh Ritz method, exact v/s approximate solution, beam elements.

UNIT-II

2-D Problems: Plane stress and plane strain conditions, triangular elements, constant strain triangle, linear strain triangle, Boundary conditions, body forces and stress recovery, quadrilateral elements.

UNIT-III

2-D Problems: Lagrange and Serendipity shape functions, iso-parametric formulation, numerical integration, modeling with iso-parametric elements, requirements for convergence, patch test, nonconforming elements, and reduced integration.

UNIT-IV

3-D Problems: Axisymmetric solids, governing equations, axisymmetric elements and their applications, mixed formulations, bending of flat plates (Kirchhoff Theory), continuity requirements and boundary conditions.

UNIT-V

3-D Problems: Discrete Kirchhoff's elements, thick plate elements, plate bending applications, shells as assemblage of flat plates, finite element formulation for dynamic problems, mass properties, introduction to elastic stability for frames and plates.

TEXT BOOKS

1. **"Concepts and Applications of Finite Element Analysis"**; by Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt; Wiley; 4th Edition; 2001.
2. **"Finite Element Method"**; by C.S. Krishnamurti; Tata McGraw-Hill Education; 2nd Edition; 2013.
3. **"Finite Element Procedures"**; by K.J. Bathe; Prentice Hall; 2nd Edition; 2014.

REFERENCE BOOKS

- **"An Introduction to the Finite Element Method"**; by J.N. Reddy; McGraw-Hill; 3rd Edition; 2005.
- **"Fundamentals of Finite Element Analysis"**; by S.S. Rao; Wiley; 3rd Edition; 2010.
- **"Finite Element Analysis: Theory and Practice"**; by Manish Shrikhande; Cengage Learning; 1st Edition; *2021*.

AUTOMATION IN ADVANCED MANUFACTURING SYSTEMS

Subject Code: 26MCM1E32	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Understand principles and strategies of automation in production systems
- Design and analyze material handling, fluid power, and pneumatic systems
- Analyze and design manufacturing systems, assembly lines, and implement flexible manufacturing systems

COURSE OUTCOMES

CO 1	Understand the principles of automation in production systems, material handling techniques, and lean manufacturing concepts.
CO 2	Analyze and design fluid power and pneumatic systems, including hydraulic and pneumatic circuits for automation.
CO 3	Design and evaluate automated and manual assembly lines using mathematical models of manufacturing systems.
CO 4	Design automated production lines and flexible manufacturing systems, incorporating power transmission, work transfer, and system configurations.
CO 5	Implement cellular manufacturing systems and apply quality control techniques, including statistical methods and TQM.

SYLLABUS

UNIT-I

Introduction to Automation in Production System: Manual labor in production systems, Principles and strategies of automation, Basic elements of an automated system, Levels of automation, Production concepts and mathematical models

Material Handling: Introduction to material handling, Material handling equipment, Principles and design considerations in material handling, Material transport equipment, Automated storage systems, Lean manufacturing

UNIT-II

Fluid Power: Introduction to fluid power, Pascal's Law, Hydraulic circuit design and analysis, Control of a single-acting hydraulic cylinder circuit, Control of a double-acting hydraulic cylinder circuit, Regenerative cylinder circuit.

Pneumatic Systems: Basic pneumatic systems, Types of cylinders: single-acting and double-

acting cylinders, Direction control valves: valve position, shuttle valve, Basic pneumatic circuits: control of single-acting and double-acting cylinders, Impulse operation and pilot operation of cylinders

UNIT-III

Manufacturing Systems: Introduction to manufacturing systems, Components of manufacturing systems, Classification scheme for manufacturing systems, Mathematical models of production performance.

Assembly Lines: Overview of manual assembly lines, Automated production lines, Single-station manufacturing cells, Alternative assembly lines.

UNIT-IV

Automated Production Lines: Overview of automated production lines, Applications of automated production lines, System configurations, Work part transfer mechanisms, Storage buffers, Power transmission systems: gears, power screws (linear guideways), chains, and ropes. **System Design Considerations:**System design and layout considerations, Design challenges in automation systems

Flexible Manufacturing Systems: Introduction to FMS, Components and applications of FMS, Benefits and planning/implementation issues.

UNIT-V

Cellular Manufacturing and Flexible Manufacturing Systems: Introduction to Part Families, Manufacturing Cells, Cellular Manufacturing, Part classification and coding, Production Flow Analysis, Group Technology and its applications.

Inspection and Quality control: Introduction to quality control, Specifying limits of variability, Dimensions and tolerances, Selection of gauging equipment, Statistical quality control, total quality management (TQM), six sigma, Coordinate measuring machines

TEXT BOOKS

1. **"Automation, Production Systems, and Computer-Integrated Manufacturing"**; by Mikell P. Groover; Pearson Education; **5th Edition**; **2015** (latest).
2. **"Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design"**; by **Yoram Koren**; Wiley; **2nd Edition**; **2010**.

REFERENCE BOOKS

- **"Fluid Power with Applications"**; by Anthony Esposito; Pearson; **7th Edition**; **2013**.
- **"Pneumatic Systems: Principles and Maintenance"**; by S.R. Majumdar; Tata McGraw-Hill; **2nd Edition**; **2011**.

- **"Industrial Robotics: Technology, Programming, and Applications"**; by Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey; Prentice Hall; **2nd Edition**; **2008**.
- **"Computer Based Industrial Control"**; by Krishna Kant; PHI Learning; **2nd Edition**; **2010**.

DESIGN OF ROBOTIC SYSTEMS

Subject Code: 26MCM1E41	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Understand the mechanics and kinematics of industrial robots
- Develop mathematical models for trajectory planning and robotic control
- Design and implement robotic work cells and control systems

COURSE OUTCOMES

CO 1 Demonstrate the relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CO 2 Apply the concepts of coordinate transformations for development of arm equation and subsequently the inverse kinematics model for given serial manipulator.

CO 3 Develop and analyze the mathematical model for trajectory planning, resolved motion rate control and dynamics model for a given serial robotic manipulator

CO 4 Develop the algorithms for design of robotic work cell controller and its programming

CO 5 Studying and Understanding Sensing and Vision systems

SYLLABUS

UNIT-I

Introduction: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers-Proportional, Integral, Differential, PID controllers

UNIT-II

Kinematics of Robot Manipulator: Introduction, General Mathematical Preliminaries on Vectors& Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations,, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation. D H Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation. Introduction, Trajectory

Interpolators.

UNIT-III

Dynamics of Robotic Manipulators: Introduction, Preliminary Definitions, Generalized Robotic Coordinates, Jacobian for a two link Manipulator, Euler Equations, and The Lagrangian Equations of motion. Application of Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with Distributed Mass.

UNIT-IV

Robot Programming: Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc.

UNIT-V

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

TEXT BOOKS

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007
2. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
3. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.

REFERENCE BOOKS

- Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
- Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.

AR-26 / M.TECH. / CIM **I Year II Semester**

LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Subject Code: 26MCM1E42	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend the fundamentals and scope of logistics and supply chain management
- Implement effective warehousing and inventory management techniques
- Apply strategies and technologies for optimized supply chain operations

COURSE OUTCOMES

CO 1	Understand the fundamentals and scope of logistics
CO 2	Comprehend the components and significance of supply chain management
CO 3	Apply strategies for supply chain operations and planning
CO 4	Design and align supply chain strategy with business objectives
CO 5	Utilize advanced analytics and technologies in supply chain management

SYLLABUS

UNIT-I

Introduction to Logistics: Introduction to Logistics, Modern Logistics, Manufacturing and service Logistics: National and International Scenario, Key Performance Areas of Logistics: Transportation, Supply, Distribution, Warehousing and Order management; Tools for Improving Logistics Efficiency

UNIT-II

Introduction to Supply Chain Management: Definition and scope of Supply Chain Management- Importance and benefits of SCM- Key components of a supply chain- Types of supply chain models: Manufacturing and Service in SC, Supply chain performance metrics

UNIT-III

Supply Chain Strategy: Supply Chain Strategy-Introduction,key drivers of Supply Chain, Models for developing Supply Chain Strategy; Make-or-Buy Decisions - agile and lean manufacturing-applications.

UNIT-IV

Supply Chain network: Objectives of Supply Chain Networks; Factors influencing Supply Chain Network Decisions; Framework of Network Design- Supply Chain Segmentation. Principle Streams of Supply Chain: 1st stream, 2nd stream, and 3rd stream.

UNIT-V

Supply Chain Analytics and Technology: Supply chain data analytics and visualization- Predictive analytics and forecasting- Supply chain optimization techniques- Blockchain, IoT and AI tools - applications

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TEXT BOOKS

1. Logistics Management" by Dr. R. S. Kushwaha and Dr. A. K. Singh (Vikas Publishing House)
2. "Logistics and Supply Chain Management" by Dr. S. S. Gupta and Dr. A. K. Sharma (McGraw Hill Education)

REFERENCE BOOKS

- "Logistics Management" by Donald J. Bowersox, David J. Closs, and M. Bixby Cooper
- "Warehousing and Inventory Management" by Dr. S. S. Gupta and Dr. A. K. Sharma
- "Supply Chain Management: Strategy, Planning, and Operation" by Sunil Chopra and Peter Meindl.

SIMULATION LAB

Subject Code: 26MCM1103	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- To perform finite element analysis on various components and structural elements and find the deflections and stresses for different loading conditions.
- To calculate the natural frequencies and forced response for 2D and 3D structures using FEA.
- To conduct heat transfer analysis and determine the temperature distribution in a composite slab and fin.

COURSE OUTCOMES

CO 1	Determine deflections and stresses in 1D bars, trusses, and beams
CO 2	Perform static analysis of 2D structures
CO 3	Determine deflections and stresses in 3D bodies
CO 4	Conduct static FE analysis of 3D shell components
CO 5	Estimate natural frequencies and mode shapes of 1D bar and 2D beams

SYLLABUS

EXPERIMENT

1. Determination of nodal displacements, stresses and reactions of given axial loaded bar structure and validating with theoretically calculated FE solution.
2. Determination of nodal displacements, stresses and reactions of given axial loaded bar structure with wall gap and validating with theoretically calculated FE solution.
3. Determination of nodal displacements, stresses and reactions of given axial loaded bar structure with temperature effects and validating with theoretically calculated FE solution.
4. Determination of nodal displacements, stresses and reactions of a given element plane truss arrangement and validating the same with theoretically calculated FE solution.
5. Determination of nodal displacements, stresses and reactions of a given standard bridge plane truss structure and validating the same with theoretically calculated FE solution.
6. Static analysis of 2D cantilever beams and determines deflections, stresses and

reactions with point and distributed loads, validating the same with theoretically calculated FE solution.

7. Static analysis of 2 DoF, determine deflections of simply supported beams, stresses and reactions with point and distributed loads, validating the same with theoretically calculated FE solution.
8. Static analysis of 2DoF, determine deflections of fixed beams, stresses and reactions with point and distributed loads, validating the same with theoretically calculated FE solution.
9. Eigen value modal analysis of 1D stepped bar to determine natural frequencies & dynamic mode shapes, validating the same with theoretically calculated FE solution.
10. Eigen value modal analysis of 2 D beam to determine natural frequencies & dynamic mode shapes, validating the same with theoretically calculated FE solution.

AR-26 / M.TECH. / CIM **I Year II Semester**

RESEARCH METHODOLOGY AND IPR

(Common for all M.Tech. Specializations)

Subject Code: 26MCC1001	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Formulate research problems with clarity and develop strong analytical skills.
- Apply structured research methodology, literature review techniques, and ethical practices to academic work.
- Interpret research data effectively and master the mechanics of technical report writing.
- Gain a comprehensive understanding of Intellectual Property Rights (IPR) and the legalities of the patenting process.
- Understand the global landscape of patent rights, technology transfer, and emerging trends in IP.

COURSE OUTCOMES

CO 1	Summarize the fundamental concepts, types, and systematic processes of scientific research.
CO 2	Formulate a well-defined research problem by applying systematic selection techniques
CO 3	Construct a comprehensive literature review and theoretical framework while maintaining high ethical standards.
CO 4	**Execute** data interpretation and produce high-quality technical reports and oral presentations.
CO 5	Navigate the legalities of Intellectual Property Rights, including patent filing, licensing, and emerging IP trends.

SYLLABUS

UNIT-I: Introduction to Research Methodology

Meaning, objectives, and motivation in research.**Research Taxonomy:** Types of research (Descriptive vs. Analytical, Applied vs. Fundamental, and Quantitative vs. Qualitative).**Methodology:** Research approaches, significance of research, and the distinction between Research Methods vs. Methodology.**Scientific Rigor:** Research and the scientific method; Importance of understanding the research process from inception to completion.

UNIT-II:Defining the Research Problem

Quality Standards: Criteria of good research; Common problems encountered by researchers in India. **Problem Formulation:** The art of defining the research problem;

Necessity and importance of a well-defined problem. **Techniques:** Step-by-step process of identifying and selecting a research problem. **Application:** Practical illustrations and the logic of narrowing down a broad area into a researchable topic.

UNIT-III: Literature Review and Research Ethics

Strategic Review: Place of literature review in research; Bringing clarity and focus to the problem; improving methodology and broadening knowledge base. **Execution:** Searching existing literature, reviewing selected literature, and contextualizing findings. **Frameworks:** Developing theoretical and conceptual frameworks for the study.**Integrity:** Writing about the literature reviewed; **Analysis of Plagiarism** and adherence to **Research Ethics**.

UNIT-IV:Interpretation and Report Writing

Data Synthesis: Meaning and techniques of interpretation; Precautions to take during data interpretation. **Technical Communication:** Significance of report writing; Different steps and layout of a formal research report. **Formatting & Mechanics:** Types of reports, oral presentation skills, and the mechanics of writing a research report. **QualityControl:**Precautions for writing effective and accurate research reports.

UNIT-V: Nature of Intellectual Property and Patenting

IP Fundamentals: Nature of Intellectual Property: Patents, Designs, Trademarks, and Copyrights. **The Patent Lifecycle:** From technological research and innovation to development; Procedure for grant of patents. **Global Framework:** International cooperation on IP; Patenting under the **Patent Cooperation Treaty (PCT)**. **Rights & Trends:** Scope of patent rights; Licensing and transfer of technology; Patent databases. **Emerging Areas:**Geographical Indications (GI), Traditional knowledge case studies.

TEXT BOOKS

1. Kothari, C. R(1990). Research methodology, 2nd edition, New Age International Publishers.
2. Kothari, C. R., & Garg, G. (2024). Research methodology: Methods and techniques (5th ed.). New Age International Publishers.
3. Ramappa, T. (2021). Intellectual property rights under WTO (3rd ed.). S. Chand Publishing.

REFERENCE BOOKS

- Chawla, D., & Sondhi, N. (2016). *Research methodology: Concepts and cases* (2nd ed.). Vikas Publishing House.
- Cornish, W., Llewelyn, D., & Aplin, J. (2025). *Intellectual property: Patents, copyright, trade marks and allied rights* (10th South Asian ed.). Sweet & Maxwell.
- Controller General of Patents, Designs and Trade Marks. (2024). *Manual of patent practice and procedure*. IP India Official Website.
- World Intellectual Property Organization. (2024). PCT – The International Patent System. WIPO.