FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD101T	Computer Integrated Manufacturing	3	-		3	30	70	100

Course Objectives	Course Outcomes
1. To develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques. **2.** To develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality**.**	• Study the application of computers in manufacturing sector. • Get acquainted with Group Technology & classification and coding • get acquainted with various FMS systems concepts. • get acquainted with various Manufacturing Planning and control like process planning, CAQC, JIT • recognize NC, CNC and DNC manufacturing and generate APT & manual part program for CNC machining.

Unit I	**[8Hrs]**
Introduction: Fixed, Programmable and Flexible Automation, Classification of automated manufacturing systems based on product variety & production volume. Evolution of CIM, Segments of CIM, Computer aided Design, Computer Aided Manufacturing, Computer controlled business functions. Overview of CIM software's.	
Unit II	**[8Hrs]**
Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT, Part families , classification and coding, Machine cell design, PFA	
Unit III	**[8Hrs]**
Introduction to flexible manufacturing systems, Subsystems of FMS, Types of FMS layouts. Introduction to Automated inspection devices: Coordinate Measuring Machine (CMM), Inspection probes etc .Automated storage &retrieval systems.	
Unit IV	**[8Hrs]**
Manufacturing Planning and control: Automated process planning: Retrieval & Generative Expert process planning, Introduction to process planning software's. Manufacturing Production Planning: Aggregate Production planning, Master production schedule, Materials requirement planning, Capacity requirement planning, JIT Production system. Computerized statistical process control, Shop floor control, Shop floor data collection techniques, CAQC,	
Unit V	**[8Hrs]**
Concepts of NC, CNC, DNC. Classification of CNC machines, Machine configurations, Types of control, CNC controllers characteristics, Interpolators. Cutting tool materials, carbide inserts classification, qualified; semi-qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices, of CNC Machines. Programming CNC machines, Part print analysis and Process planning, Advanced Programming features, Canned cycles, Subroutines, Macros, special cycles etc. Manual part programming for CNC turning, milling and machining center.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Automation, Production Systems and Computer Integrated Manufacturing	Mikell P. Groover		Prentice Hall publication
2.	Computer Integrated Design and Manufacturing	David Bedworth, Etal		McGraw Hill Book Co
3.	Computer Aided Design and Manufacturing	Mikell P. Groover and Zimmers E.W		Prentice Hall Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	CAD, CAM, CIM	P. Radhakrishnan		New Age International Pvt. Ltd
2.	CNC Technology and Programming	Krar, S., and Gill, A		McGraw Hill pub. Co

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD101P	Computer Integrated Manufacturing Lab			4	2	50	50	100

Course Objectives	Course Outcomes
1 Develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques. 2 Develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.	• Recognize automation and CIM, CIM wheel, hardware, software, components of CIM • Apply fundamentals of G.T and FMS • Apply fundamentals of CAPP and CAQC • Develop CNC programs for manufacturing applications.

Minimum 8 experiments to be performed

Expt. No.	Title of the experiment
1	Introduction to CIM. (Product Development Cycle, CIM Wheel)
2	Introduction to NC(Basic components, classification)
3	Part classification and Coding using G.T.
4	Study of F. M. S
5	Study of CAPP Systems. (Retrieval & Generative)
6	Study of different quality measurement tools.
7	Simulation on CNC Lathe & CNC Milling (one program each)
8	Manual Part Programming–Lathe.
9	Manual Part Programming– Milling
10	Manual Part Programming by using Sub routine& Canned Cycles

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Numerical Control And Computer Aided Manufacturing	Rao, N K Tiwari, T K Kundra	13th edition (2007)	Tata McGraw-Hill Education
2.	Computer Control of Manufacturing Systems	Koren	2005	Mcgraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	G.T Planning and Operation, in The automated factory Hand Book: Technology and Managemen	Askin, R.G. and Vakharia, A.J Cleland, D.I. and Bidananda,	1991	B (Eds), TAB Books, NY
2.	Planning, design and analysis of cellular manufacturing systems	Kamrani, A.K, Parsaei	1995	H.R and Liles, D.H. (Eds) Elsevier

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD102T	Computer Aided Design	3			3	30	70	100

Course Objectives	Course Outcomes
To understand the role of computer graphics in CAD/CAM and contemporary terminology, progress issues and trends in computer graphics. Also, to understand the computer graphics techniques such as geometric transformations, geometric algorithms, 3Dmodeling, vector representation of geometric entities, 3D object models (surface, volume and implicit), visible surface algorithms	• Develop GUI for various engineering applications. • Model the object using various geometrical entities. • Develop various surfaces using analytical approach and parametric modeling. • Develop the models, assembly design and perform simulation using CAD software's tools. Also, determine various physical properties of solid models. • Optimize the design using Johnson optimization technique for normal, redundant specification problem.

Unit I **[8Hrs]**

Introduction: Computer Graphics, computer aided design process, development of graphics systems, display devices, image generation, image storage, introduction to image processing, vector representation of geometric entities like line, circle, ellipse, arc etc.

Unit II **[8Hrs]**

2-D and 3-D transformations: Translation, scaling, rotation, reflection, homogeneous representation, concatenated transformations, translational mapping rotational mapping, general mapping, inverse transformations and mapping, introduction to windowing and clipping algorithms, viewing transformations.

Unit III **[8Hrs]**

Curves and surface representation: curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations, Surface representation, parametric Representation of surfaces.

Unit IV **[8Hrs]**

Fundamentals of 3-D modeling: Introduction to modeling techniques, Coordinate system, Datum features, Geometric constraints, boundary representation (B-rep), Constructive Solid Geometry (CSG), sweep representation, blend representations; solid manipulations (displaying, editing, transformations, windowing and clipping). Solid modeling based applications (calculations of mass properties, CG, inertia, surface analysis etc.), 2-D drafting features, representation of dimension/tolerances/symbols & annotation, tolerance analysis, associativity, parent child relationship.

Unit V **[8Hrs]**

Optimization: Introduction, Johnson method of optimization normal specification problem, redundant specification problem, introduction to genetic algorithm.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Computer Graphics in Mathematical Approaches	D P Kothari, G K Awari, D D Shrimankar, Amit Bhende	2017	New Age International New Delhi
2.	CAD /CAM Theory and Practice	Ibrahim Zeid	International Edition, 1998	McGraw Hill,
3.	CAD/CAM Principles, Practice and Manufacturing Management	Chris McMohan and Jimmi Browne	2000	Pearson Education Asia,Ltd

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Mathematical Elements for Computer Graphics	Rogers/Adams	1985	McGraw Hill
2.	Computer Graphics: A Programming Approach	Harington Stevan	1983	McGraw Hill

		August 2024	1	Applicable for 2024-25
Chairman - BoS	Dean – Academics	Date of Release	Version	

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD102P	Computer Aided Design Lab			4	2	50	50	100

Course Objectives	Course Outcomes
To understand the role of computer graphics in CAD/CAM and contemporary terminology, progress issues and trends in computer graphics. Also, to understand the computer graphics techniques such as geometric transformations, geometric algorithms, 3Dmodeling, vector representation of geometric entities, 3D object models (surface, volume and implicit), visible surface algorithms	• Design a computer system by selecting different input and out devices required for graphic application. • Write, compile and troubleshoot a computer program from the basic geometrical entity generation algorithm • Write, compile and troubleshoot a computer program to transform an object. • Optimize an engineering problem using appropriate optimization technique

- **Minimum eight experiments to be performed from the list**

Expt. No.	Title of the experiment
1	To study various input/ output devices for development of any graphics system.
2	To study DDA line generation algorithm and its program.
3	To study Bresenham's line generation algorithm and its program.
4	To study Bresenham's mid-point circle generation algorithm and its program.
5	To study Bresenham's mid-point ellipse generation algorithm and its program.
6	To study 2D Basic transformations and its program.
7	To study 2D special transformations and its program.
8	To generate a 3D model by using any modeling software.
9	To study Normal specification optimization problem and its program.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Computer Graphics in Mathematical Approaches	D P Kothari, G K Awari, D D Shrimankar, Amit Bhende	2017	New Age International New Delhi
2.	CAD /CAM Theory and Practice	Ibrahim Zeid	International Edition, 1998	McGraw Hill,
3.	CAD/CAM Principles, Practice and Manufacturing Management	Chris McMohan and Jimmi Browne	2000	Pearson Education Asia,Ltd

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Mathematical Elements for Computer Graphics	Rogers/Adams	1985	McGraw Hill
2.	Computer Graphics: A Programming Approach	Harington Stevan	1983	McGraw Hill

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD103T	Industrial Robotics and Machine Vision	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To understand constructional details and operations of robot 2. To learn design of kinematic and dynamics of robot. 3. To enable learning about constructional and operational details of robotics as well as programming. 4. To understand sensor and machine vision system for the said application.	• Explain the basic principles of Robotic technology, configurations, control and programming of Robots. • Design an industrial robot which can meet kinematic and dynamic constraints. • Describe the concept of Robot kinematics and dynamics, latest algorithms & analytical approaches • Discuss and apply the concepts of dynamics for a typical Pick and Place robot • Choose the appropriate Sensor and Machine vision system for a given application.

Unit I **[9Hrs]**

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 Sub-assemblies.Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers Proportional, Integral, Differential, PID controllers. (SLE: Types of Drive Systems and their Relative Merits) 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, Homogeneous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll Pitch-Yaw (RPY) Transformation. DH Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation.(SLE: Geometrical Approach to Inverse Kinematics.)

Unit II **[9Hrs]**

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, Homogeneous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll Pitch-Yaw (RPY) Transformation. DH Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation. (SLE: Geometrical Approach to Inverse Kinematics.)

Unit III **[9Hrs]**

Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories. General Design Consideration on Trajectories:- 4-3-4 & 3-5-3 Trajectories. (SLE: Admissible Motion Trajectories) Dynamics of Robotic Manipulators: Introduction, Preliminary Definitions, Generalized Robotic Coordinates, Jacobian for a Two link Manipulator, Euler Equations, 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. (SLE: Dynamic Equations of Motion for A General Six Axis Manipulator)

Unit IV **[9Hrs]**

Dynamics of Robotic Manipulators: Introduction, Preliminary Definitions, Generalized Robotic Coordinates, Jacobian for a Two link Manipulator, Euler Equations, 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, Two Link Robotic Dynamics with Distributed Mass.(SLE: Dynamic Equations of Motion for A General Six Axis Manipulator)

Unit V **[9Hrs]**

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, visual servo-control. Application of Robotics: Applications of robotics in active perception, medical robotics, autonomous vehicles, and other areas.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Digital Image Processing	Rafael C. Gonzalez and Richard E. Woods	3rd International edition	Pearson Education
2.	Robot vision	Bershold Klaus, Paul Holm		The MIT press

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Digital Signal Processing	N. G. Palan		Tech-Max...Publication
2.	Digital Signal Processing (Principles, Algorithms and applications)	John G. Prokis, Dimitris G. Manolakis		PHI. Publication

		August 2024	1	Applicable for 2024-25
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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD104T(i)	Design of Hydraulic And Pneumatic Systems	3	-		3	30	70	100

Course Objectives	Course Outcomes
• To impart students on the science, use and application of Hydraulics and Pneumatics as Fluid Power in Industry. • To introduce the basic components and functions of hydraulic and pneumatic system elements such as pumps, control valves, control assemblies, actuators, switching and control devices and use standard symbols. • To enable students to acquire the knowledge and skills to apply hydraulic and pneumatic principles to the design and control of automated systems. • To understand the operation of hydraulic and pneumatic power systems for their maintenance and troubleshooting	• Describe the function and operation of hydraulic and pneumatic system. • Identify components of hydraulic systems, using symbols and schematics, with a view to design and assemble a fluid power system. • Understand and design electro-hydraulic and electro-pneumatic circuits using schematic diagrams. • Describe the principles and construction of various components of pneumatic systems. • Demonstrate appropriate use of test equipment, find fault, evaluate circuit performance and apply appropriate troubleshooting techniques to rectify problems of hydraulic and pneumatic power systems.

Unit I	**[6Hrs]**
Introduction: Introduction to Hydraulics and Pneumatics, their structure, Advantages and Limitations. Properties of Fluids, Fluids for Hydraulic systems, Governing laws. Distribution of fluid power, ISO symbols, Energy losses in Hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis and their sizing. Performance curves and parameters.	
Unit II	**[6Hrs]**
Hydraulic actuators, types and constructional details, sizing criteria, lever systems, control elements – direction, pressure and flow control valves, valve configurations, general valve analysis, valve lap, flow forces and lateral forces on spool valves, series and parallel pressure compensation flow control valves, flapper valve analysis and design.	
Unit III	**[6Hrs]**
Proportional control valves and servo valves, non-linearities in control systems (backlash, hysteresis, dead band and friction non-linearities), design and analysis of typical hydraulic circuits,regenerative circuits, high low circuits, synchronization circuits,meter-in, meter-out and bleed-off circuits, fail safe and counterbalancing circuits, Locked cylinder using pilot check valves, Hydraulic Motor Breaking System, accessories used in fluid Power system, filtration systems and maintenance of system.	
Unit IV	**[6Hrs]**
Pneumatic Systems: Pneumatic, Fundamentals, Merits & Demerits over Hydraulic systems, Pneumatic Conditioners-Filters-Regulators-Lubricators-Mufflers- Air dryers, Types of Air Compressors, Pneumatic Actuators, direction, flow and pressure control valves in pneumatic systems Design of Pneumatic Circuits. valves for logic functions, time delay valve, exhaust and supply air throttling, travel-dependent control and time dependent control, combined control. Fluid Circuit Failures: Common causes of failure dirt- Heat-Misapplication -Improper fluids – Faulty Installation – Improperly designed Circuits. Maintenance: Maintenance of Hydraulic & Pneumatic Circuits. Valves for logic functions, time delay valve, exhaust and supply air throttling	
Unit V	
Hydraulic and Pneumatic Design: Design of Hydraulic & Pneumatic circuit for specific application- Cascading – Ladder diagram (Electrical controls), Microprocessor controlled design of Circuits, Circuits for Copying, Lathe, Broaching Machines & Milling Machines. Applications in assembly, feeding, metal working, materials handling and plastics working. Servo systems, hydro mechanical servo systems, electro hydraulic servo systems and proportional Valves, fluidics – Principles of Fluid Logic Control, introduction to fluidic devices, Fluidic Sensors, simple circuits, introduction to electro hydraulic pneumatic ,logic circuits, ladder diagrams, PLC applications in fluid power control, fluid power circuits; failure and troubleshooting.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Pneumatic Systems: Principles and Maintenance	S. R. Majumdar	2015	McGraw Hill Education, Print.
2.	Fluid Power with Applications	Antony Espossito	1980	Prentice Hall, Print

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Pneumatics & Hydraulics	Harry L. Stewart		D.B. Taraporevala sons
2.	Fluid Power Trouble Shooting	Hehn Anton, H		Marcel Dekker Inc., New York

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD104T(ii)	Machinery Fault Diagnosis	3		-	3	30	70	100

Course Objectives	Course Outcomes
At the end of this course, the student will able to understand the basics of Condition Monitoring Techniques (CBM) which would give insight into machine fault finding in mechanical components. The student will be able to select appropriate instrumentation for CBM. The signals sensed by the instrumentation can be analyzed using appropriate signal processing techniques. Further the student will be able to explore the research prospect in the area of CBM.	• To identify and distinguish between the types of machinery failure • To select appropriate maintenance strategy for machine condition monitoring. • To select appropriate signal processing technique to detect machine fault. • To develop data acquisition system for machine fault diagnosis. • To analyse signal for determination of presence of fault, location of fault, level of fault severity and remaining useful life of component.

Unit I	**[8Hrs]**
Machinery failure, Causes of failure,Types of failure, Frequency of failure	
Unit II	**[8Hrs]**
Basic Maintenance Strategies, Run to Failure (Breakdown Maintenance), Preventive Maintenance, Condition Based (Predictive, Proactive, Reliability Centered, On-Condition) Maintenance, Factors which influence Maintenance Strategy, Machine Condition Monitoring, Periodic Monitoring, Continuous Monitoring	
Unit III	**[8Hrs]**
Classification of signals, Signal generation from various failures, Data Acquisition, Signal Conditioning, Signal Processing, Signal Processing Techniques, Selection of Signal Processing Techniques	
Unit IV	**[8Hrs]**
Types of Sensors, Selection of Sensors, Selecting and Configuring DAQ Measurement Hardware, Software for Data Acquisition.	
Unit V	**[8Hrs]**
Fault diagnostics, Bearing Fault, Gear Fault, Balancing Defects, Shaft Misalignment	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Vibration-Based Condition Monitoring –Industrial, Aerospace and Automotive applications	Robert Bond Randall	2011	John Wiley & Sons Ltd
2.	Maintenance Engineering and Management	R. C. Mishra, K. Pathak	2002	Prentice Hall of India Pvt. Ltd.

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Machinery Condition Monitoring Principles and Practices	Dr. Amiya R. Mohanty		CRC Press
2.	Introduction to Machinery Analysis and Monitoring	John S. Mitchell		Penn Well Books

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD104T(iii)	Tribology in Design	3	-		3	30	70	100

Course Objectives	Course Outcomes
i) Theories of friction, wear and lubrication and their practical applications ii) Developing tribological solutions to problem iii) Design of hydrodynamic and rolling contact bearings.	• Apply theories of friction and wear to various practical situations by Analyzing the physics of the process. • Select materials and lubricants to suggest a tribological solution to a Particular situation. • Design a hydrodynamic bearing using various bearing charts. • Design rolling element bearings, determine its life. • Understand the various surface measurement techniques and effect of surface texture on tribological behavior of a surface.

Unit I	**[8Hrs]**
SURFACES, FRICTION AND WEAR: Topography of Surfaces, Surface features, Surface interaction, Theory of Friction, Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials, Friction in extreme conditions, Wear, types of wear, Mechanism of wear, wear resistance materials, Surface treatment, Surface modifications, Surface coatings.	
Unit II	**[8Hrs]**
LUBRICATION THEORY: Lubricants and their physical properties lubricants standards, Lubrication Regimes in Hydrodynamic lubrication, Reynolds Equation, Thermal, inertia and turbulent effects, Elasto hydrodynamic (EHD) magneto hydrodynamic lubrication, Hydro-static lubrication, Gas lubrication, Solid lubrication.	
Unit III	**[8Hrs]**
DESIGN OF FLUID FILM BEARINGS: Design and performance analysis of thrust and journal bearings , Full, Partial, Fixed and pivoted journal bearings design, Lubricant flow and delivery, Power loss, Heat and temperature of steady and dynamically loaded journal bearings, Special bearings, Hydro-static Bearing design.	
Unit IV	**[8Hrs]**
ROLLING ELEMENT BEARINGS: Geometry and kinematics, Materials and manufacturing processes, Contact stresses, Hertzian stress equation, Load divisions, Stresses and deflection, Axial loads and rotational effects, Bearing life capacity and variable loads, ISO standards, Oil films and their effects, Rolling Bearings Failures.	
Unit V	**[8Hrs]**
TRIBO MEASUREMENT AND INSTRUMENTATION: Surface Topography measurements, Electron microscope and friction and wear measurements, Laser method, Instrumentation, International standards, Bearings performance measurements, Bearing vibration measurement.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Basic Lubrication Theory	Cameron	1981	Ellis Horwood Ltd
2.	Fundamentals of Fluid Film Lubrication	B. J. Hamrock,	1994	McGraw Hill International

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Introduction to Tribology of Bearings	B. C. Majumdar	1985	A.H. Wheeler & co. pvt. ltd

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD105T(i)	Advanced Materials Engineering	3			3	30	70	100

Course Objectives	Course Outcomes
This course is aimed to understand & develop fundamentals in selecting appropriate materials for industrial and engineering applications. This course also aims to compute the mechanical properties of engineering materials using various testing methods. To study the structure and properties of engineering materials. Studying concept to avoid failures with respect to fatigue, creep and fracture.	• Understand the fundamentals of various engineering materials, properties and their crystal structure. • Compute the mechanical properties of engineering materials using tension and torsion testing. • Compute the mechanical properties of engineering materials using fatigue testing. • Estimate the creep behavior • Realize the significance of fracture mechanics.

Unit I	**[8Hrs]**
STRUCTURE AND PROPERTIES: Structure of metals, Defects in crystals, Deformation, Relationship between structure and properties, Mechanical properties of metals, Strain hardening, Strengthening mechanisms.	
Unit II	**[8Hrs]**
TENSION AND TORSION: Stress - Strain curve, Measures of yielding, Measures of ductility, Toughness, Flow curve, Effect of temperature on flow properties, Anisotropy, mechanical properties in torsion, Method of measuring shear stress, Types of torsion failures, Torsion test Vs Tension test. Stress –Strain curve of composite materials.	
Unit III	**[8Hrs]**
FATIGUE: Fatigue phenomena, Theories of fatigue failure, Evaluation of fatigue resistance, Methods of presenting fatigue data, Fatigue crack propagation, Parameters influencing fatigue, Cyclic stress strain behavior, Design against fatigue, Low cycle fatigue.	
Unit IV	**[8Hrs]**
CREEP: Description of creep, Creep curve, Stress-rupture test, Creep mechanisms Dislocation glide, Diffusion flow, Dislocation and Diffusion, Creep in two phase alloys, Deformation Mechanism Maps, Materials aspects creep design, Estimates of creep behavior, Presentation of Engineering creep data Super plasticity.	
Unit V	**[8Hrs]**
FRACTURE MECHANICS: Types of fracture, Theoretical strength of a solid, Griffith's Theory, Irwin-Orowan Theory crack propagation Modes, Dislocation Theories of Brittle fracture, Ductile fracture, Analysis of crack propagation, Stress intensity factor, Crack opening displacement, integrals-Fracture toughness measurement methods.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Engineering Materials and Metallurgy	U. C. Jindal	2011	Pearson
2.	Mechanical Metallurgy	George E. Dieter	1988	McGraw Hill
3.				

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Process of Creep and fatigue of Metals	Kennedy, A. J	1958	Industrial Press,

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD105T(ii)	Reliability Engineering	3			3	30	70	100

Course Objectives	Course Outcomes
● Demonstrate the approaches and techniques to assess and improve process and/or product quality and reliability. ● Introduce the principles and techniques and their practical uses in product and/or process design and monitoring. ● Illustrate the basic concepts and techniques of modern reliability engineering tools.	• Understand and explain the concepts of reliability, maintainability etc. • Analyse the data related to reliability and develop prediction models • Perform reliability management tasks like testing, growth monitoring, Allocation and replacement models • To perform reliability risk assessment and analysis

UNIT 1:. Reliability Concept: Reliability function-failure rate - Mean Time Between Failures (MTBF) - Mean Time to Failure (MTTF) –failure modes and effects and criticality analysis (FMECA) , mortality curve –use full availability–maintainability-system effectiveness. **[8 Hours]**
Unit II: Reliability Data Analysis: Time-to-failure distributions - Exponential, normal, Gamma, Weibull, ranking of data-probability plotting techniques-Hazard plotting. **8 Hours]**
Unit III:. Reliability Prediction Models: Series and parallel systems – RBD approach-Stand by systems-m/n configuration-Application of Baye's theorem –cut and tie set method**. [8 Hours]**
Unit IV:. Reliability Management: Reliability testing-Reliability growth monitoring-Non-parametric methods Reliability and life cycle costs-Reliability allocation. **[8 Hours]**
Unit V: Risk Assessment: Definition and measurement of risk - risk analysis techniques-risk reduction resources–industrial safety and risk assessment. **[8 Hours]**

Text Books

S.N	Title	Authors	Edition	Publisher

Reference Books

1	Reliability Engineering and Quality Management	O. N. Pandey, Bhupesh Aneja		S. K. Kataria & Sons
2	Practical Reliability Engineering	Patrick D T O'Connor	4th Edition	Wiley India

S.N	Title	Authors	Edition	Publisher
1	Reliability And Maintenance Engineering	R C Mishra		New Age International New Delhi
2	Reliability Engineering And Risk Analysis: A Practical Guide	Mohammad Modarres, Mark P. Kaminskiy, Vasiliy Krivtsov		Taylor & Francis Ltd

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD105T(iii)	Artificial Intelligence	3			3	30	70	100

Course Objectives	Course Outcomes
In this course, the students will study, analyze and simulate various Artificial Intelligence (AI) Techniques and Expert Systems. They will develop the concepts of AI in real life applications, use of AI in machine through the Natural Language Programming (NLP),the architecture of expert systems and understand the knowledge rule based systems in AI. They will also learn object oriented programming system in expert system.	• Apply the basics of AI and expert system to analyze practical problems. • Select appropriate AI & expert systems and tools for solving real life • Problems and their analysis. • Develop the knowledge base for solving real life engineering problem. • Use neural network in cellular manufacturing and other areas of mechanical engineering. • Understand advanced computing techniques that would help in further research and development.

UNIT 1: Human and machine intelligence, artificial intelligence (AI), programming in AI environment, natural language processing (NLP), architecture of an expert system. **[8 Hours]**

Unit II: Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic, selection of inference mechanism, semantic nets, structure and objects, ruled systems for semantic nets,-certainty factors, automated learning. **[8 Hours]**

Unit III:. Introduction to rule based system, conflict resolution, advantages and drawbacks of rule based systems clausal form logic; rule base verification, refinement and validation creating knowledge base, knowledge engineer and domain expert, phases of knowledge engineering, tools for knowledge engineering. **[8 Hours]**

Unit IV:. Neural network (NN) applications, artificial neural network models (ANN), NN applications in cellular manufacturing and other areas of mechanical engineering **[8 Hours]**

Unit V: : Fundamentals of OOP (Object Oriented Programming), creating structures and objects, object operations, invoking procedures, programming applications, object oriented expert systems. Advanced topics. **[8 Hours]**

Text Books

S.N	Title	Authors	Edition	Publisher
1	Designing Knowledge Based System'	Addis, T. R	1985	Prentice Hall
2	Principles of Artificial Intelligence and Expert Systems Development	Rolston, D.W	1988	McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Rule based expert systems	Sasikumar, Ramani		
2	Handbook of Expert Systems in Manufacturing	Maus, R. and Keyes, J	1991	McGraw Hill

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD201T	Adv Finite Element Method	3			3	30	70	100

Course Objectives	Course Outcomes
The objective of the course is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues as well as providing hands-on experience using finite element software for modeling & analyzing stresses, strains, deformations, natural frequencies, modal shapes, etc. for machine/structural components.	• Identify the application of fundamentals of solid mechanics for evaluation of structural problems for evaluation of Point load, body force, traction and torsional loads. • Study the application and formulation of the basic finite elements for static and truss, beam and bars subjected to plane stress and plane strain behavior. • Formulate mathematical models for the solution of common engineering problems using finite element methods i.e, formulation of simple & complex problems using finite elements and to develop the ability to generate the governing finite element equations for systems regulated by partial differential equations. • Identify the significance and difference between the formulation and application of thermal engineering problems using1D & 2D finite elements. • Formulate dynamic problems to study and evaluate structural response under free vibration.

Unit I	**[8Hrs]**
Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, vibrational approach, Glerkin's Methods. Coordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.	
Unit II	**[8Hrs]**
1-D STRUCTURAL PROBLEMS: Axial bar element–stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems. Plane Trusses and Axi-symmetric Truss elements, and problems Beam bending problem, Hermite shape functions–stiffness matrix– Load vector.	
Unit III	**[8Hrs]**
2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Iso-parametric elements–quadrilateral element, shape functions–Numerical Integration. Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. 3-DPROBLEMS: Tetrahedran element–Jacobian matrix–Stiffness matrix.	
Unit IV	**[8Hrs]**
SCALAR FIELD PROBLEMS:1-D Heat conduction-Slabs–fins-2-D heat conduction problems –Introduction to Torsional problems.	
Unit V	**[8Hrs]**
Dynamic considerations, Dynamic equations–consistent mass matrix– Eigen Values, Eigen vector, natural frequencies–mode shapes–modal analysis	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to Finite Elements in Engineering	Chandrupatla T. R. and Belegunda A. D		Prentice Hall.
2	First Course in the Finite Element Method	Daryl Logan		Cengage Learning

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Finite Element Procedures	Bathe K. J		Prentice-Hall of India
2	Finite Element Analysis, Theory, and Practice	Fagan M. J.		Pearson Education Limited

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD201P	Advance Finite Element Methods Lab			4	2	50	50	100

Course Objectives	Course Outcomes
• To teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues. • To provide hands-on experience for using finite element software for modeling & analyzing stresses, strains, deformations, natural frequencies, modal shapes, etc. for machine/structural components. • To enable understanding of design evolution cycle through process of design validation	• Model finite element problems using commercial software and understand the fundamental use of finite element preprocessor, solver and post-processor. • Demonstrate the ability to evaluate and interpret Finite Element Analysis Results for the design and evaluation of 1D and 2D finite element formulations. • Understand the Finite Element Modeling aspects of the Frequency response problem for solving engineering design problems.

- **Minimum eight experiments to be performed from the list (**Minimum Six Practical on the standard CAE packages like HYPERWORKS, ANSYS, NASTRAN, ABAQUS, or any other relevant software or freeware.

Expt. No.	Title of the experiment
1	Static structural analysis of Axially loaded bar with 1-D finite elements using standard FEA package.
2	Static structural analysis of bar under the influence of self-weight using 1-D finite elements using standard FEA package.
3	Static structural analysis of bar under applied torque using 1-D finite elements using standard FEA package.
4	Static structural analysis of 1D truss using standard FEA package.
5	Static structural analysis with 2-D Plane stress element using standard FEA package.
6	Static structural analysis with 2-D Plane strain element using standard FEA package.
7	Static structural analysis of a beam under transverse loading using standard FEA package.
8	Dynamic structural analysis to determine natural frequency and mode shapes, using standard FEA package.
9	Thermal analysis to estimate nodal temperatures using standard FEApackage.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to Finite Elements in Engineering	Chandrupatla T. R. and Belegunda A. D		Prentice Hall.
2	First Course in the Finite Element Method	Daryl Logan		Cengage Learning

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Finite Element Procedures	Bathe K. J		Prentice-Hall of India
2	Finite Element Analysis, Theory, and Practice	Fagan M. J.		Pearson Education Limited

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD202T	Computer Aided Tool Design	3			3	30	70	100

Course Objectives	Course Outcomes
i) To create complete understanding about design of cutting tools used in metal removal processes. ii) To make students understand different types of press working operations and their die design. iii) To make students well versed with principles and design of jigs and fixtures. iv) To provide knowledge about forging die design and mold design.	• Perform analysis of forces on cutting tools in metal removal process and Design single and multi-point cutting tools. • Design various press working cutting operation dies for given sheet metal parts, also will be able to suggest heat treatment cycle for these dies. • Understand terminologies and design considerations related to press working bending, forming and drawing dies. • Explain and classify various forging dies and design machine forging dies. • Design simple, blow and injection molds for plastic parts. • Design jigs and fixtures by considering principles of location and clamping.

Unit I **[8Hrs]**

Design of single point & multi-point cutting tools: Design of single Point Cutting Tool: Form tools- Introduction, Types, design of form tools. Design of multi-point cutting tools: Drills-Introduction, Types, Geometry, Design of drill, Milling cutters-Introduction, Types, Geometry, and Design of milling cutters.

Unit II **[8Hrs]**

Press working (Cutting operation dies): Introduction, Press working operations, construction and working of metal cutting dies e.g. simple die, compound die, progressive die, combination die. Design of heat treatment cycle for press tools, Principle of metal cutting, press tonnage capacity, cutting forces, method of reducing cutting forces. Blanking & Piercing die design– Simple, compound & progressive dies.

Unit III **[8Hrs]**

Press Working (Bending Forming & Drawing dies): Bending dies: Bending terminology, types of bending operation, blank development, spring back and its prevention, bending force and design of bending dies. Forming dies: Introduction, types of forming dies - Solid form dies, pad type form dies, curling dies, embossing dies, coining dies and its design. Drawing dies: Metal flow in drawing operation, factors affecting metal flow, calculation of number of draws, development of blank, drawingforce,blankholdingforceanddesignofvarioustypesofdrawingdies i.e. single action draw die, double action draw die and invert eddies.

Unit IV **[8Hrs]**

Forging Die Design & Mold Design: Introduction, Classification of forging dies, Single impression dies, Multiple Impression dies and Forging design factors. Preliminary forging operation-fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design for machine forging in closed & open die forging, materials of forging dies. **Mould Design**: Design of Simple Blow Moulds for Articles such as bottles, cans Design of simple two plate injection moulds, Mould Materials.

Unit V **[8Hrs]**

Design of jigs &fixture:- Introduction, general principles for design of jigs and fixtures, principle of location, principle for clamping, clamping devices, types of jig bushes, material and heat treatment, design of drill jig. Design of Milling Fixtures and lathe fixtures.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Production Engineering	P. C. Sharma		S. Chand Publication
2	Tool Design	Donaldson		Tata McGraw Hill, New Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Manual of Jigs and Fixtures Design	Henrickson		Industrial Press Inc., New York

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD202P	Computer Aided Tool Design Lab			4	2	50	50	100

Course Objectives	Course Outcomes
This course deals with various types of cutting tools, the mechanics of metal cutting, design of gauges, design of metal cutting tools and also to understand various press working operations along with die design for sheet metal working, basics of forging dies and design of jigs and fixtures.	• Design single and multi-point cutting tools. • Design various press working cutting operation dies for given sheet metal parts. • Design various forging dies and design machine forging dies. • Design simple, blow and injection molds for plastic parts. • Design jigs and fixtures by considering principles of location and clamping.

- **Minimum eight experiments to be performed from the list**

Expt. No.	Title of the experiment
1	**Design of single point cutting tool(SPCT):** Theory of metal cutting, Tool geometry and nomenclature, One numerical on SPCT and boring tool
2	**Design of Press Working Cutting Operation Dies (Blanking and Piercing):** Analytical design (finalization of all dimensions), Preparation of 3-D model of complete Die Block using CAD software., 3-D assembly model, 2-D drafting model showing assembly views, exploded views, BOM and balloons, 2-D detailing of assembly parts.
3	**Design Press Working (Bending Forming & Drawing dies):** Analytical design (finalization of all dimensions), Preparation of 3-D model of complete Die Block using CAD software., 3-D assembly model, 2-D drafting model showing assembly views, exploded views, BOM and balloons.
4	**Design of Forging Dies:** Analytical design (finalization of all dimensions), Preparation of 3-D model of complete using CAD software, 3-D assembly model, 2-D drafting model showing assembly views, exploded views, BOM and balloons, 2-D detailing of assembly parts.
5	**Design of Blow Mould:** Analytical design (finalization of all dimensions), Preparation of 3-D model of complete using CAD software, 2-D detailing of mould.
6	**Design of Drill Jig:** Problem statement and analysis of requirements, Development of initial ideas (Locating and clamping devices, jig body etc.), Final Design of jig using 3-D modeling CAD software's: 3-D assembly model, 2-D drafting model showing assembly views, exploded views, BOM and balloons, 2-D detailing of assembly parts.
7	**Design of Fixtures:** Problem statement and analysis of requirements., Development of initial ideas(Locating and clamping devices, jig body etc.), Final Design of fixture using 3-D modeling CAD software's: 3-D assembly model, 2-D drafting model showing assembly views, exploded views, BOM and balloons, 2-D detailing of assembly parts.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Production Engineering	P. C. Sharma		S. Chand Publication
2	Tool Design	Donaldson		Tata McGraw Hill, New Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Manual of Jigs and Fixtures Design	Henrickson		Industrial Press Inc., New York

		August 2024	1	Applicable for 2024-25
Chairman - BoS	Dean – Academics	Date of Release	Version	

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD203T	Product Design and Development	3			3	30	70	100

Course Objectives	Course Outcomes
The primary objective of this course is to make students well conversant with Product Development (New or existing) and various aspects involved in it.	• Understand the importance of product design and development • Select material, manufacturing process for development of product • Apply principals for DFM, DFA, DFX concurrent engineering for Generation of product • Understand and apply product development cycle.

Unit I	**[8Hrs]**
Importance of product design, types of design, product definition, product specification, Phases of product development: conceptual, embodiment and detailed design, product and technology development cycle, concept generation and evaluation methods.	
Unit II	**[8Hrs]**
Material selection – Importance, classification, material performance characteristic, Selection criteria, Ashby Material selection chart Process selection–Importance, types of manufacturing processes and their classification, sources of information, selection criteria, Material and Process selection Methods-Expert systems, Computer Database Approach, Performance indices, decision matrix, AHP and fuzzy approach, introduction to material and process selection software.	
Unit III	**[8Hrs]**
Benchmarking – DFM, DFA, DFX, Early supplier involvement, robust design, QFD and concurrent engineering. Mathematics of Time Value of Money, Cost Comparison, Depreciation, Taxes, Inflation, Profitability of Investment and Investment Decision Analysis Sensitivity Analysis. Methods of Cost Estimates.	
Unit IV	**[8Hrs]**
Industrial Engineering Approach, Parametric Approach, Introduction to Assembly Modeling, Top-Down and Bottom-Up Approaches of AM, Mating Conditions, Representation Schemes, Generations of Assembly Sequences.	
Unit V	**[8Hrs]**
Product Development Cycle and Importance of Prototyping, Types of Prototypes, Principle and Advantages & Different Type of Generative Manufacturing Process, Viz, Stereo lithography, FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Considerations	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Engineering Design	Dieter George E	2000	McGraw Hill Pub. Company
2	Product Design and Development	Ulrich Karl T. and Eppinger Steven D	2005	McGraw Hill Pub. Company

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Product Design & Manufacturing	Chitale, Gupta	2nd Ed 2002	Prentice Hall of India

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD204T(i)	Design of Material Handling	3			3	30	70	100

Course Objectives	Course Outcomes
The overall objective of this course is to understand and learn about various industrial mechanical handling devices starting from their basic design for any desired condition and its safety analysis with its theoretical knowledge.	• To understand the importance of material handling systems, basic principles, Functions and classifications • To perform selection, feasibility analysis and economic analysis of material handling system for particular application. • To design elements of hoisting systems and bucket elevator to understand working and constructional details of various conveying systems and design belt conveyor system. • To design various types of factory cranes and its structures.

Unit I	**[8Hrs]**
Elements of Material Handling System:- Importance, terminology, objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and Plant layout, physical facilities and other organizational functions; Classification of Material Handling equipment's.	
Unit II	**[8Hrs]**
Selection of Material Handling Equipments:- Factors affecting for selection; Material Handling equation; choices of Material Handling equipment; general analysis procedures; basic analytical techniques; The unit load concept; selection of suitable types of systems for applications; activity cost data and economic analysis for design of component so Material Handling Systems; functions and parameters affecting service; packing and storage of materials.	
Unit III	**[8Hrs]**
Design of hoisting elements: Welded and roller chains- Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eyehooks – crane grabs - lifting magnets - Grabbing attachments – Design of arresting gear-Brakes: shoe, band and cone types. Design of bucket Elevator: Introduction, Types of Bucket Elevator, Design of Bucket Elevator- loading and bucket arrangements, Cage elevators, shaft way, guides, counter weights.	
Unit IV	**[8Hrs]**
Conveyor Design: Introduction to apron conveyors, Pneumatic conveyors, Belt Conveyors, Screw conveyors and vibratory conveyors, Escalators and their applications, Design of Belt conveyor-Belt selection procedure and calculation of drop energy, Idler design.	
Unit V	**[8Hrs]**
Design of Cranes: Hand-propelled and electrically driven E.O.T overhead Traveling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary rotary and traveling rotary cranes.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Material Handling Equipments	N. Rudenko		Peace Publishers
2	Material Handling System Design	James M. Apple		John-Willey and Sons Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Bulk Solid Handling	C. R. Cock and J. Mason		Leonard Hill Publication Co. Ltd
2	Material Handling Hand Book	Kulwiac R. A.,		John Wiley Publication

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD204T(ii)	Design for Manufacturing and Assembly	3			3	30	70	100

Course Objectives	Course Outcomes
To make students conversant with concepts of product development cycle considering design, manufacturing and assembly aspects.	• Understand the concept of product development cycle. • Select suitable engineering material and suggest shape of product. • Suggest suitable product design considering manufacturing process. • Suggest suitable product design considering the process of assembly. • Include reliability and optimization aspect in product design.

Unit I **[8Hrs]**

Introduction Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes.

Unit II **[8Hrs]**

Properties of Engineering Materials, Selection of Materials–I, Selection of Materials–II, Case Studies–I, Selection of Shapes, Co-Selection of Materials and Shapes, Case Studies–II.

Unit III **[8Hrs]**

Selection of Manufacturing Processes, Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co-selection of Materials and Processes, Case-Studies– III

Unit IV **[8Hrs]**

Design for Assembly, Review of Assembly Processes, Design for Welding–I, Design for Welding–II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies -IV

Unit V **[8Hrs]**

Design for Reliability, Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Materials and Design-the art and science of material selection in product design	M F Ashby and K Johnson		Butterworth-Heinemann
2	Engineering Design-a materials and processing approach	G Dieter		McGraw Hill, NY

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Engineering Optimization: theory and practice	S S Rao	1996	John Wiley, NY
2	Product design for manufacture and assembly	G Boothroyd, P Dewhurst and W Knight	1994	John Wiley, NY: Marcel Dekkar

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD204T(iii)	Additive Manufacturing	3			3	30	70	100

Course Objectives	Course Outcomes
1. Use commercial software for digitizing free-form geometry. 2. Create the design of an object suitable for additive manufacturing processes. 3. Compare traditional versus next generation manufacturing. 4. Define and apply criterion for selecting appropriate additive manufacturing process for any given application.	• Explain the evolution of additive manufacturing (AM) and its importance in digital manufacturing. Also, create AM process chain for product. • To create and pre-process a model for additive manufacturing. • Understand explain liquid based and solid based additive manufacturing processes • Understand and explain powder based additive manufacturing process. • Explain 3-dimensional printing and post process the additive manufactured parts.

Unit I **[8Hrs]**

Introduction: Need - Development of Additive Manufacturing (AM) systems, Distinction between AM & CNC machining, AM process chain: Conceptualization, 3D Scanning & the Scanning Process, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and cleanup, post-processing. Impact of AM on Product Development - Virtual Prototyping – Rapid Tooling–Rapid Prototyping (RP) to AM-Classification of AM processes, Benefits and Applications.

Unit II **[8Hrs]**

Reverse engineering and CAD modeling: Basic concepts-Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements. Introduction to Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM –Case studies.

Unit III **[8Hrs]**

Liquid based and Solid based additive manufacturing systems: Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, Recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications –Case studies.

Unit IV **[8Hrs]**

Powder based additive manufacturing systems: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS-powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications–Case Studies.

Unit V **[8Hrs]**

Other Additive Manufacturing systems: Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Post processing of AM parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing	Gibson, I., Rosen, D.W. and Stucker, B	2010	Springer
2	Rapid Prototyping: Principles &Applications	Chua Chee Kai, Leong Kah Fai	2003	World Scientific

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Rapid prototyping	Gebhardt, A	2003	Hanser Gardener Publications
2	Rapid Prototyping and Engineering applications : A tool box for prototype development	Liou, L.W. and Liou, F.W	2011	CRC Press

		August 2024	1	Applicable for 2024-25
Chairman - BoS	Dean – Academics	Date of Release	Version	

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD205T(i)	Manufacturing System Integration and Management	3			3	30	70	100

Course Objectives	Course Outcomes
Develop an understanding of Manufacturing Systems: manufacturing Planning, Computer integrated Production management Systems, Manufacturing Resources Planning (MRP III) and JIT concept with Simulation: Need of simulation, Simulation languages and Package	• Identify components of Manufacturing System, classification, manufacturing progress function. Single station manufacturing cells: Single station manned workstations, automated cells, analysis of single station cells. • Get acquainted With Manufacturing Planning, softwares, CAPP, And Group Technology. • Get acquainted With Various Computer integrated Production management Systems (CAQC,SFC) • Get acquainted With Manufacturing Resources Planning (MRP III), JIT concept • Get acquainted with simulation, Simulation languages & Packages, methodology. Types Even Scheduling Approach (ESA), Activity scanning Approach (ASA), Process Interaction Approach (PIA)

Unit I **[8Hrs]**

Introduction to Manufacturing Systems: components of Manufacturing System, classification, manufacturing progress function. single station manufacturing cells: Single station manned workstations, Automated cells, Applications, analysis of single station cells.

Unit II **[8Hrs]**

Manufacturing Planning: Automated process planning: Process planning, general methodology of group technology, part identification and coding, Retrieval & Generative CAPP systems. Introduction to process planning software.

Unit III **[8Hrs]**

Computer integrated Production management Systems Aggregate Production Planning and Master Production Schedule, Material Requirement Planning, Capacity Planning, Manufacturing system control: Computerized statistical process control, Shop floor control, Shop floor data collection techniques, CAQC, Bill of materials. Business functions: Purchase orders receiving, Inventory management, financial control, Job costing, Sales & Marking applications

Unit IV **[8Hrs]**

Manufacturing Resources Planning (MRPIII): Framework Of MRPII System, Elements Of MRPII. Value Added Focus, Source of waste, JIT principles, The Meaning of JIT, Small Lot Production, Setup Time Reduction, Pull Production: Production Control Systems, Pull And Push System, Process Improvement, Necessary Conditions For Pull Production Systems, How To Achieve Pull Production, Mechanisms For Signal, To Pull or Production, Kanban, lean production, Agile manufacturing.

Unit V **[8Hrs]**

Simulation: Need of simulation, Simulation languages & Packages, Simulation methodology. Types of simulation approaches- Even Scheduling Approach (ESA), Activity scanning Approach (ASA), Process Interaction Approach (PIA), interfacing requirements for integrating manufacturing systems.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Group Technology in Engineering Industry	Bubidge, J. L	1979	Mechanical Engineering Pub, London
2	G. T. Planning and Operation, in the Automated Factory- Handbook: Technology and Management	Askin, R. G. and Vakharia, A. J	NY1991	cleland, D. I. And Bidananda, B (Eds), TAB Book

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Competitive Manufacturing Management	Nicholes John M.	Intl edition	McGraw Hill

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD205T(ii)	Modeling and Simulation	3			3	30	70	100

Course Objectives	Course Outcomes
To provide students with basic principles of discrete- event simulation which leads to develop and analyze computer simulation models of existing and proposed manufacturing, service and business systems.	• Define the basics of simulation modeling and replicating the practical situations in organizations. • Generate random numbers and random variants using different techniques. • Analysis of Simulation models using input analyzer, and output analyzer • Students will learn to simulate the models for the purpose of optimum control by using software

Unit I **[8Hrs]**

Introduction to simulation as a tool, Areas of application, System model, Components of system, System environment, Types of system model, Steps in a simulation study. Discrete event system simulation, Event scheduling, Time advance mechanism, List processing – basic properties and operations, Dynamic allocation, linked lines. Characteristics of queuing systems, Transient and steady-state behaviour, Long run performance measures, Infinite-population steady-state models, Finite-population models.

Unit II **[8Hrs]**

Properties and generation of random numbers, Testing of generated random numbers. Random Variate Generation : Exponential, Uniform, Weibull, Triangular, Empirical, Discrete distributions, Direct transformation for normal distribution, Convolution method ,Acceptance-rejection technique

Unit III **[8Hrs]**

Analysis of simulation data: data collection, identifying distributions, Parameter estimation, Goodness of-fit tests, Multivariate and time series input models.

Unit IV **[8Hrs]**

Model building, Verification, Validation process, Verification of simulation models, Calibration and validation of models: Validation of assumptions, Input-output transformations, Validation of input output using historical data and turning test. Estimation of absolute performance.

Unit V **[8Hrs]**

Optimization and Design of Systems: Summary of gradient based techniques: Nontraditional Optimization techniques, genetic Algorithm (GA)- coding, GA operations elitism, Application using MATLAB: Simulated Annealing Neural Network Modeling of Systems only with Input-output Database: Neurons, architecture of neural networks, knowledge representation, learning algorithm. Multi-layer feed forward network and its back propagation learning algorithm, Application to complex engineering systems and strategy for optimum output. Modeling Based on Expert Knowledge: Fuzzy sets, Membership functions, Fuzzy Inference systems, Expert Knowledge and Fuzzy Models, Design of Fuzzy Controllers, Simulation of Engineering Systems: Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable Examples from engineering problems

Text Books

S.N	Title	Authors	Edition	Publisher
1	Discrete-Event System Simulation	J. Banks		PHI
2	Simulation Modeling and Analysis	S. Law		McGraw Hill Publishing Co

Reference Books

S.N	Title	Authors	Edition	Publisher
1	System Simulation	J. Gordon		PHI
2	Simulation Modeling & Analysis	A. M. Law & W. D. Keltron		McGraw Hill International series
	Automation, Production Systems and Computer Integrated Manufacturing	Mikell P. Groover		PHI

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD205T(iii)	Agile Manufacturing	3			3	30	70	100

Course Objectives	Course Outcomes
1. To impart knowledge of Agile Manufacturing, its need and strategies. 2. To make students conversant in process development in agile manufacturing/ enterprise. Integrating Product/Process development.	• Understand conceptual frame work of agile manufacturing environment. • Get insight into Enterprise design process, apply interdisciplinary design concepts. • Apply IT/ES concepts in agile manufacturing and supply chain. • Understand and explain computer control of agile Manufacturing. • Suggest enhance technology for machine tool and system.

Unit I **[8Hrs]**

Agile Manufacturing: Definition, business need, conceptual frame work, characteristics, generic features. Four Core concepts: Strategy driven approach-integrating organization, people technology, interdisciplinary design methodology.

Unit II **[8Hrs]**

Developing Agile Manufacturing: Enterprise design, System concepts as the basic manufacturing theory-joint technical & Organizational design and a model for the design of agile manufacturing enterprise. Enterprise design process insights into design processes, what is interdisciplinary design, main issues, simple design example. Integration of Product /Process Development: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches.

Unit III **[8Hrs]**

Application of IT/ES Concepts In Agile Manufacturing: Strategies, Management of complexities and information. flow, approaches, applications of multimedia to improve agility in manufacturing, system concepts. Agile Supply Chain Management: Principles, IT/ES concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and learners– comparison of concepts.

Unit IV **[8Hrs]**

Computer Control of Agile Manufacturing: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, and examples. Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in Agile manufacturing, Role of standards.

Unit V **[8Hrs]**

Design of Skill & Knowledge: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Agile Manufacturing- Forging Mew Frontiers'	Poul T Kidd	1994	Amagow Co. UK
2	Agile Manufacturing	A Gunasekharan		Elsevier Press, India

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Levine Transitions to Agile Manufacturing	Joseph C Moutigomery and Lawrence	1996	Milwaukee. Wisconsin, USA
2	Agile Development for Mass Customization	David M Anderson and B Joseph Pine,	1997	Irwin Professional Publishing, Chicago, USA,.

THIRD SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD302T(i)	Supply Chain Management	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
To provide knowledge of strategic importance of supply chain design and planning of an organization, the role of inventory management and forecasting in a supply chain, facility planning and scheduling models.	• Define the goal of a supply chain and analysis the impact of supply chain • Decisions on the success of a firm and Identify drivers of supply chain performance. • Analyse demand forecasts and supply for both an enterprise and a supply chain • Apply operations planning, MRP, and aggregate planning concepts in a supply chain. • Design a supply chain network for a firm or organisation • Judge and select the best supplier for a firm or organisation

Unit I	**[8Hrs]**
Introduction to Supply Chain Management: Understanding thesupply chain, Supply Chain Performance- Achieving strategic fit and scope, complexity, key issues, Supply Chain Drivers and Metrics, Centralized vs. decentralized systems	
Unit II	**[8Hrs]**
Planning Demand and Supply in a Supply Chain: Forecasting-Need for forecasting, Quantitative methods. Inventory Management- Various costs in inventory management and need, Deterministic models and discounts, Probabilistic inventory management. Aggregate Planning The Role of Aggregate Planning, Aggregate Planning Strategies.	
Unit III	**[8Hrs]**
Facility Planning and Scheduling models: Facility layout and location-Qualitative aspects, Quantitative models for layout decisions, Product, process fixed position, group layout, Location decisions-quantitative models. Scheduling models-Scheduling in MRP system, Sequencing rules and applications, Batch production sequencing and Scheduling.	
Unit IV	**[8Hrs]**
Designing the Supply chain network: Distribution Networks–Design options for a distribution network, e-Business and the distribution network, Network design in an uncertain environment. Transportation Networks-Design options for a transportation network, Trade-offs in transportation design, Supply Chain Optimization	
Unit V	**[8Hrs]**
Managing Cross-Functional Drivers in a Supply Chain: Sourcing Decisions-Make or buy decisions, Third-and fourth-party logistics providers, Sourcing Processes. Pricing and Revenue Management in a Supply Chain, Information Technology in a Supply Chain,Coordination in a Supply Chain	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Supply Chain Management, strategy, planning, and operation	Chopra, S., and Meindl, P.	2nd	PHI
2.	Operations Management	Evans and Collier		

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Logistics and Supply Chain Management	Christopher		Pearson Education Asia
2.	Manufacturing Operations and Supply Chain Management (The LeanApproach)	Taylor and Brunt		BusinessPressThomson Learning,NY

THIRD SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD302T(ii)	Advance Mechanism Design	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
To make students well versed with advance concepts of mechanism analysis like kinematic analysis, position and displacements, synthesis of mechanism and analysis of robotic arm.	• Understand basic mechanisms in machines. DOF • Performa kinematic analysis various mechanisms for velocity and acceleration. • Determine position and displacements of moving points of mechanisms. • Synthesize tvarious mechanisms • Perform forward and inverse kinematics of robotic arm and its linkages.

Unit I	**[8Hrs]**
Introduction: Review of fundamentals of kinematics, Mobility analysis, Formation of one D.O.F. multi loop kinematics chains, Network formula: Gross motion concepts	
Unit II	**[8Hrs]**
Kinematic Analysis: Position Analysis: Vector loop equations for four bar, Slider crank, inverted slider crank, Geared five bar and six bar linkages, Analytical methods for velocity and acceleration analysis, Four bar linkage jerk analysis, Plane complex mechanisms.	
Unit III	**[8Hrs]**
Position and Displacement: Locus of moving point, position of point, position difference between points, apperent and absolute position of points, Loop closure equation, Graphical position analysis	
Unit IV	**[8Hrs]**
Synthesis of Mechanism: Type synthesis, Number synthesis, Associated Linkage Concept, Dimensional synthesis, function generation, Path generation, Motion generation, Graphical Methods, Cognate linkages, Coupler curve synthesis, Design of six-bar mechanisms. Algebraic methods, Application of instant center in linkage design. Cam Mechanisms, determination of optimum size of Cams.	
Unit V	**[8Hrs]**
Robotics: Introduction, Topological arrangements of robotic arms, forward kinematics, Inverse position analysis, Inverse velocity and acceleration analysis, Robot actuator force analysis	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Theory of Machines and Mechanisms	Shigley J.E., and Uicker, J.J.,	1995	McGraw Hill, 1995
2.	Theory of Mechanism and Machines	Amitabha Ghosh and Asok Kumar Mallik	1999	EWLP, Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Design of Machinery	Sandor G.N., and Erdman A.G	1995	Prentice Hall
2.	Manufacturing Operations and Supply Chain Management (The LeanApproach)	Nortron R.L	1999	McGraw Hill

THIRD SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD303T (i)	Industrial Safety	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
The objectives of subject is to prevent accidents in industry by reducing any hazard to minimum and to reduce workman's compensation, insurance rate and all the cost of accidents along with improvement in occupational health and safety and its management	• Develop students to handle the complex industrial environment • Give knowledge about occupational health, industrial hygiene, accidental prevention techniques to the students. • Make the student aware about safety auditing and management systems, pollution prevention techniques etc. • Train the students about risk assessment and management in Industry

Unit I	**[8Hrs]**
Occupation, Safety And Management; Occupational Safety, Health and Environmental Safety, Management – Principles & practices, Role of Management in Industrial Safety, Organization Behavior on Human factors contributing to accident.	
Unit II	**[8Hrs]**
Planning for Safety: Planning: Definition, purpose, nature, scope and procedure. Management by objectives and its role in Safety, Health and Management (SHE)	
Unit III	**[8Hrs]**
Monitoring for Safety, Health & Environment: Occupational Safety, Health and Environment Management System, Bureau of Indian Standards on Safety and Health: 14489 – 1998 and 15001 – 2000, ILO and EPA Standards. Principles of Accident Prevention: Definition: Incident, accident, injury, dangerous, occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes etc.	
Unit IV	**[8Hrs]**
Education, Training and Employee Participation in Safety: Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Competence Building Techniques (CBT), Concept for training, safety as a on-line function. Employee Participation: Purpose, areas of participation, methods, Role of trade union in Safety, Health and Environment Protection.	
Unit V	**[8Hrs]**
Management Information System: Sources of information on Safety, Health and Environment Protection. Compilation and collation of information, Analysis & use of modern methods of programming, storing and retrieval of MIS for Safety, Health and Environment. QCC HS Computer Software Application and Limitations.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Industrial Safety , Health and Environment Management Systems	R.K. Jain and Sunil S. Rao,	2006	Khanna publishers, New Delhi
2.	Industrial Safety and Environment	A.K. Gupta	3rd	Laxmi Publications Pvt Ltd

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Industrial Safety, Health Environment and Security	Basudev Panda	-	Laxmi Publications Pvt Ltd

THIRD SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CAD303T(ii)	Operations Research	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
To make students well versed with advance concepts of Operations research like dynamic programming, non-linear programming, sensitivity analysis and other real world problems.	• Students should able to apply the dynamic programming to solve problems of discreet and continuous variables. • Students should able to apply the concept of non-linear programming • Students should able to carry out sensitivity analysis • Student should able to model the real world problem and simulate it.

Unit I	**[8Hrs]**
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	
Unit II	**[8Hrs]**
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	
Unit III	**[8Hrs]**
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	
Unit IV	**[8Hrs]**
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	
Unit V	**[8Hrs]**
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Operations Research, An Introduction	H.A. Taha	2008	PHI
2.	Principles of Operations Research	H.M. Wagner	1982	PHI

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Introduction to Optimisation: Operations Research	J.C. Pant	2008	Jain Brothers, Delhi
2.	Operations Research	Pannerselvam	2010	Prentice Hall of India