### Semester – I

<table>
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<tr>
<th>S. No</th>
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<td>Theory of Metal Cutting and Tool Design</td>
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<td>Advanced Computer Aided Design and Analysis Lab</td>
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<td>Audit Course-I</td>
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**Total Credits 18**

### Semester – II

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<td>Mini Project with Seminar</td>
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**Total Credits 18**
### Semester – III

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<td>Design for Manufacturing and Assembly</td>
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<td>Manufacturing Systems, Simulation modeling and analysis</td>
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<td>Open Elective</td>
<td>Advanced Casting and Welding Technology</td>
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<td>Advanced Robotics</td>
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**Total Credits** 16

### Semester – IV

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<tr>
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<td>Dissertation Phase - II</td>
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**Total Credits** 16
THEORY OF METAL CUTTING AND TOOL DESIGN  
(Core - 1)

M.Tech. (AMS) (FT) – I Sem


Objectives:
- To impart the knowledge of basic methodology of metal cutting.
- To educate the student about the structure, working, forces involved in single point and multipoint cutting tools.
- To understand the concepts of tool life, machinability, wear, influence of heat.
- To design the jigs and fixtures required for machine tools.

Outcomes: Students can analyze the machining processes in terms of input variables like
- Speed, feed, depth of cut and their influence on surface roughness and performance measures, Metal removal rate, tool wear rate, machining time, energy, work done, heat distribution.

UNIT-I: 

UNIT-II: 
Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools, throwaway inserts.

UNIT-III: 
Multi point Cutting Tools: Drill geometry, design of drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, Milling Cutters-cutting speed & feed – machining time – design - From Cutters.
Grinding: Specifications of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature, power.

UNIT-IV: 
Tool Life and Tool Wear: Theories of tool wear-adhesion, abrasion and diffusion wear mechanisms, forms of wear. Tool life criteria, machinability and machinability index.
Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect of Tool angle, Economics, cost analysis, mean co-efficient of friction.
Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions. Temperature variation, zones, experimental techniques, analytical approach. Use of tool-work thermocouple for determination of temperature. Heat distribution in Metal Cutting.

UNIT-V: 
Tool Design: Determination of shank size for single point carbide tools, Determining the insert thickness for carbide tools.
Text Books:
2. Fundamentals of Machining by Boothryd, Edward Arnold publishers Ltd.

Reference Books:
GEOMETRIC MODELING
(Core - 2)

Course Objectives:
- Learn modeling curves (B-splines and Bezier)
- Learn modeling Bezier and B-spline surfaces
- Familiarity with NURBS
- Familiarity with advanced techniques such as subdivision and reconstruction
- Mastery of object construction and manipulation methods including lofting, surface of revolution, and tubularization.
- Mastery of Reconstruction from PCD and Mesh generation

Course Outcomes: After doing this course, the student should be able to do
- 2D & 3D transformations
- Develop cubic splines, Bezier curves and B-spline curves
- Write equations of surfaces, quadratic surfaces and analyze mathematically

UNIT–I:
Geometrical Modeling: Introduction, History, Geometrical representation, Linear Algebra Boolean Algebra, Vectors, Matrices, Equations for curves- Intrinsic and Explicit, parametric equations of curves, conic curves and points on curves, Problems

UNIT–II:
Transformations: 2-D and 3D Transformations, translation, Rotation, Homogeneous space, Scaling, stretching, Mirror reflection, Composite Transformations and problems

UNIT–III:
Cubic Splines: Algebraic and geometric force of cubic spline, parametric space of a curve, blending functions, Problems
Bezier Curves: Berustein’s polynomials, equations, control points, convex hull property, truncating and subdividing composite and Rational Bezier curves, Problems
B-Spline Curves: Uniform and non-uniform B-Spline basis functions, quadratic and cubic B-spline basis functions, NURBS, Problems

UNIT–IV:
Surfaces: Explicit and Implicit equations of surfaces, quadratic surfaces, parametric equation of surfaces, Curve Nets and Embedded Curves, Generation, Mathematical Analysis, Applications of Bezier and B-Spline Surfaces, Surface patches. Problems

UNIT–V:

Text Books:
2. CAD/CAM concepts and Applications by Alavala, PHI

Reference Books:
1. Curves and surfaces for CAGD, Fifth Edition by Gerald Farin, Elsevier, India
2. Computer Graphics by Alavala, PHI, New Delhi
3. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
AUTOMATION IN MANUFACTURING  
(Core - 3)

M.Tech. (AMS) (FT) – I Sem

Prerequisites: Production Technology, Machine Tools, Operations Research

Course Objectives:
- Lower Cost and Improve Time-to-Market
- Automation investment life-cycle analysis
- Empowered teams of talented employees
- Partnering with automation suppliers
- On-line process analysis
- Procedural process control
- Information integration and data warehousing

Course Outcomes: Upon completion of this course the student will be able to:
- Illustrate the basic concepts of automation in machine tools.
- Analyze various automated flow lines, Explain assembly systems and line balancing methods.
- Describe the importance of automated material handling and storage systems.
- Interpret the importance of adaptive control systems, automated inspection systems.

UNIT-I: 

UNIT-II:

UNIT-III:

UNIT-IV:
Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

UNIT-V:
Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.
Text Books:
1. Automation, Production systems and computer integrated manufacturing by Mikel P. Groover, Pearson Education.

Reference Books:
1. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson edu. (LPE)
ADVANCED METAL FORMING  
(Programme Elective-I)

M.Tech. (AMS) (FT) – I Sem

Prerequisites: Production Technology, Metallurgy

Course Objectives:
- Illustrate capabilities and applications of metal forming processes.
- Forming load estimation during different metal forming processes.
- To analyze residual stresses

Course Outcomes: At the end of the course, the student is able
- To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
- To study the thermo mechanical regimes and its requirements of metal forming

UNIT-I:
Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method temperature of metal working, hot working, cold working, friction and lubricants.

UNIT-II:
Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

UNIT-III:
Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. Problems on flow stress, true strain and forging load.
Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

UNIT-IV:
Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes. Problems on extrusion load,

UNIT-V:
Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defects in formed parts.
Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment and computer applications in metal forming. Problems on Blanking force, diameters and cup diameters.

Text Books:
2. Principles of Metal Working by Sunder Kumar

Reference Books:
1. Principles of Metal Working processes by G.W. Rowe
2. ASM Metal Forming Hand book.
VIBRATION ANALYSIS AND CONDITION MONITORING OF MACHINE TOOLS
(Programme Elective-I)

M.Tech. (AMS) (FT) – I Sem

Perquisites: Dynamics of Machinery, Machine Tools, Basics of Vibrations

Course Objectives:
- To apply modern vibration analysis techniques and principles for early fault detection.
- Damage prevention in critical costly industrial machines.
- Learn mechanical effects of a change in operating condition.
- Know the failure mode of each component.
- Learn prevention of unexpected break downs and perform machinery diagnosis.
- Manage the machinery reliability and trouble shooting.

Course Outcomes: At the end of the course, the student will be able to
- Exemplify and summarize the causes and effects of vibration in mechanical systems and identify discrete and continuous systems.
- Model the physical systems in to schematic models and formulate the governing equations of motion.
- Summarize the concept of mode, node and frequencies and calculate the free and forced vibration responses of multi degree of freedom systems through model Analysis.
- Ability To Use Different Techniques To Monitor The Machine Tool To Prevent From Failures

UNIT-I:

UNIT-II:

UNIT- III:
Introduction to Modeling of Continuous systems as Multi-degree of Freedom systems, Using Newton’s second law to derive equations of motion, Influence Coefficients.

UNIT-IV:
UNIT -V:
MACHINE TOOL DIAGNOSTICS: Objectives-Aims-Examples of Monitoring and Diagnosis-Control Structures For Machine Diagnosis- Utilization Of Diagnostic Results.

Text books:
2. Elements of Vibration Analysis by Meirovitch.

Reference Books:
1. Mechanical Vibrations by G.K. Groover.
MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)  
(Programming Elective-I)  

M.Tech. (AMS) (FT) – I Sem  

Prerequisites: Electronic Circuits, Basic knowledge in material science  

course Objectives:  
- To make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.  
- To design, analysis, fabrication and testing the MEMS based components.  
- To introduce the students various opportunities in the emerging field of MEMS.  

Course Outcomes: At the end of the course, the student will be able to  
- Synthesize and characterize nanomaterials for engineering applications  
- Design and analyze methods and tools for micro and nano manufacturing.  
- Improve the quality of MEMS by analyzing the variables of the underlying micro and nano manufacturing method  
- Select appropriate industrially-viable process, equipment and tools for a specific product.  

UNIT-I:  
Overview and working principles of MEMS and Microsystems: MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics  

UNIT-II:  

UNIT-III:  
Engineering Mechanics for Microsystems Design: Static Bending of Thin plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis  

UNIT-IV:  

UNIT-V:  
Materials for MEMS & Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.
Text Books:
1. Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002
2. Foundation of MEMS/ Chang Liu/Pearson, 2012

Reference Books:
PRECISION ENGINEERING
(Programme Elective-II)

M.Tech. (AMS) (FT)–I Sem

Pre-requisites: Machine Tools, Metrology

Course Objectives:
- To give the basic precision engineering methodology and state-of-the-art concepts for designing high-precision CNC machines and products.
- The course is specifically tailored to teach the novel design principles leading to improved machine performance and reliability.
- To apply the acquired knowledge to other design efforts and fields as well

Course Outcomes: At the end of the course, the student will be able to:
- Apply fits and tolerances for parts and assemblies according to ISO standards.
- Apply selective assembly concept for quality and economic production.
- Assign tolerances using principles of dimensional chains for individual features of a part or assembly.
- Evaluate the part and machine tool accuracies.
- Analyze the causes for dimensional and geometrical errors prior to and during machining and suggest remedies

UNIT-I:


UNIT-II:
Datum Systems: Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT-III:

Tolerance Charting Techniques: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and central analysis, Examples. Design features to facilitate machining; Datum Features – functional and manufacturing. Components design – Machining considerations, Redesign for manufactured parts examples

UNIT-IV:
Surface finish, Review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances sure fit law, normal law and truncated normal law.
UNIT-V:
MEASURING SYSTEMS PROCESSING: In process or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

Text Books:

Reference Books:
CONCEPTS OF COMPUTATIONAL FLUID DYNAMICS
Programme Elective –II

M.Tech. (AMS) (FT)–I Sem

Pre-requisite: Heat Transfer and Fluid Mechanics

Course Objective: To apply the principles of Heat Transfer and Fluid Mechanics to solve simple heat transfer and fluid flow problems using different numerical techniques

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

- Differentiate between different types of Partial Differential Equations and to be able to apply appropriate numerical techniques
- Solve the simple heat transfer and fluid flow problems using different numerical techniques
- Understand and to appreciate the need for validation of numerical solution

UNIT-I:


Types of Numerical Methods: Brief about FDM, FVM and FEM and comparison

UNIT-II:

Mathematical Behavior of Partial Differential Equations: Classification of Partial Differential Equations – Illustrations

Finite Difference Method (FDM): Taylor’s series – Derivation of Finite Difference Formulae for Partial Derivative Terms - Consistency

FD formulation of 1D Elliptic PDEs - 1D steady state heat transfer problems – Systems with and without Heat Generation – Simple Fin Problems - Cartesian, cylindrical and spherical coordinate systems subjected to simple boundary conditions – Validation with Analytical Solutions

UNIT-III:

Finite Difference Method: 2D Elliptic PDEs – 2D Steady State Heat Conduction Problems subjected to Dirichlet Boundary conditions


UNIT-IV:

Finite Difference Formulation of 1D Hyperbolic PDEs–CFL Condition – FD Treatment of 1D Wave Equation

UNIT-V:
**FD Formulation of Full Incompressible Fluid Flow Equations** – Lax Wendroff and Mac Cormack’s Techniques – Simple Treatment


**Text Books:**
1. Computational Fluid Flow and Heat Transfer by Muralidharan & Sundarajan (Narosa Pub)
2. Computational Fluid Dynamics and Heat Transfer by P. S. Ghoshdastidar, Centage Pub
3. Computational Fluid Dynamics by Anderson (TMH)

**Reference Books:**
1. Computational Fluid Dynamics by Hoffman and Chiang, Engg Education System
2. Computational Methods for Fluid Dynamics by Ferziger, Peric (Springer)
3. Computational Fluid Dynamics by T.J. Chung, Cambridge University
4. Computational Fluid Dynamics – A Practical Approach by Tu, Yeoh, Liu (Elsevier)
5. Text Book of Fluid Dynamics by Frank Chorlton, CBS Publishers
MECHATRONICS
(Programme Elective-II)

M.Tech. (AMS) (FT) – I Sem

Prerequisites: Engineering mechanics and mechanics of materials, Electronic circuits - analysis and design, Mathematics - Calculus, differential equations, numerical methods

Course Objective:
- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraint
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- To work efficiently in multidisciplinary teams

Course Outcomes: At the end of the course, the student will be able to:
- Model, analyze and control engineering systems.
- Control the behavior of a process using appropriate sensors, transducers and actuators.
- Develop PLC programs for a given task.
- Evaluate the performance of Mechatronic systems.

UNIT-I:


UNIT-II:
Motion control Algorithms: Significance of feed control loops, shortfalls, fundamental concepts adaptive and fuzzy control, fuzzy logic compensatory control of transformation and deformation non-linearities.

UNIT-III:
Architecture of intelligent machines: Introduction to microprocessor and programmable logic controllers and identification of system, system design classification. Motion control aspects in design

UNIT-IV:
Manufacturing Data bases: data base management systems, CAD/CAM data bases, Graphic data base, Introduction to object oriented concepts, Object oriented model languages, interface, Procedure and Methods in creation, edition and manipulation of data

UNIT–V:
Machine Vision: Future and Pattern Reorganization Methods, Concepts of Precision and cognition in decision making
Text Books:
1. Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill

Reference Books:
1. Designing Intelligent Machines by Michel B. Histand and David G. Alciatore, Open University London
2. Control Sensors and Actuators by ICW. Desiha, Prentice Hall
# AUTOMATION AND ROBOTICS LAB  
(Core Lab-I)

**M.Tech. (AMS) (FT) – I Sem**

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**Note:** Conduct any Ten exercises from the list given below:

1. Draw the circuit diagram to operate single acting pneumatic cylinder using 3/2 push button direction control valve.
2. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 direction control valve using push button momentary switch/push button latch.
3. Draw the circuit diagram to operate single acting pneumatic cylinder using 5/2 air spring valve & PLC.
4. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 air spring valve & PLC.
5. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using push button switch/latch switch.
6. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction.
7. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using PLC.
8. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/3 direction control valve (solenoid control) using PLC.
10. Inverse Kinematic Analysis of a Robot.
11. Trajectory planning of a Robot joint in Space scheme.
13. Robotic programming using SCARA.
ADVANCED COMPUTER AIDED DESIGN AND ANALYSIS LAB
(Core Lab-II)

M.Tech. (AMS) (FT) – I Sem

Note: Conduct any Ten exercises from the list given below:

1. Two-dimensional drawing using CAD software.
2. Three-dimensional drawing using CAD software.
3. Various Dimensioning and tolerancing techniques on typical products using CAD software.
4. Assembly and animation of simple assemblies like screw jack, bolt-nut mechanism, etc.
5. Truss analysis using FEA software.
7. Frame analysis using FEA software.
8. Buckling analysis of columns using FEA software.
9. Harmonic analysis using FEA software.
10. Fracture analysis using FEA software.
11. Analysis of laminated composites using FEA software.
12. Couple-field analysis using FEA software.
13. Modal Analysis
14. Transient dynamic analysis.
15. Spectrum analysis.

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# ENGLISH FOR RESEARCH PAPER WRITING

(Audit Course - I)

M.Tech. (AMS) (FT) – I Sem

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<th>Course objectives:</th>
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<td>Students will be able to:</td>
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<tr>
<td>1. Understand how to improve your writing skills and level of readability</td>
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<tr>
<td>2. Learn about what to write in each section</td>
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<tr>
<td>3. Understand the skills needed when writing a Title</td>
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Ensure the good quality of paper at very first-time submission

## Syllabus

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<tr>
<th>Units</th>
<th>CONTENTS</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness</td>
<td>4</td>
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<td>3.</td>
<td>Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.</td>
<td>4</td>
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<tr>
<td>4.</td>
<td>Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,</td>
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<td>Skills are needed when writing the Methods, Skills needed when writing the Results, Skills are needed when writing the Discussion, Skills are needed when writing the Conclusions</td>
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<td>6.</td>
<td>Useful phrases, how to ensure paper is as good as it could possibly be the first time submission</td>
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## Suggested Studies:

ADVANCED MANUFACTURING PROCESSES
(Core -4)

M.Tech. (AMS) (FT)–II Sem

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Prerequisites: Production Technology, Machine Tools, Metal Cutting, Material Science.

Course Objectives:
- To make acquainted the various unconventional manufacturing processes
- To know about the applications of advanced manufacturing processes (which are exceptional)
- To encourage the students for developing the models of Advanced Manufacturing Processes

Course Outcomes:
- At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser beam processes.
- Able to understand different types of composite material characteristics, types of micro & macro machining processes.
- Understand the e-manufacturing & nano materials.

UNIT-I:
Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT-II:

UNIT-III:

UNIT-IV:
Processing of ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics.
Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT-V:
Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics.
E-Manufacturing, nanotechnology, micromachining and High speed Machining, basic principles, working, applications, advantages.
**Text Books:**
3. Advanced Machining Processes by V.K.Jain, Allied Publications.

**Reference Books:**
5. Advanced Methods of Machining by J.A Mc Geough, Springer.
OPTIMIZATION TECHNIQUES AND APPLICATIONS
(Core -5)
M.Tech. (AMS) (FT) – II Sem

Pre-requisites: Operations Research

Course Objectives: The main objectives of the course are: Learn
- Numerical optimization techniques for single variable and multi variable non-linear optimization problems.
- Sensitivity analysis on LPP queuing
- Simulation of annexing problem & inventory problem.
- Geometry cutting plane method & branch bound method for linear IPP.
- Meaning of stochastic programming problem simple problems for finding mean variance of random variables chance constrained algorithm.
- Formulation of GP model and solving it using arithmetic geometric inequality theorem.
- State of art nontraditional optimization technique, namely genetic algorithm simulated annealing & particle swarm optimization.

Course Outcomes: At the end of the course, the student is able to apply appropriate optimization techniques and solve.
- Based on the type of optimization problem like single variable or multivariable,
- Make sensitivity analysis to study effect of changes in parameters of LPP on the optimal solution without reworking.
- Simulate the system to estimate specified performance measures.
- Solve integer programming problem by either geometry cutting plane algorithm or branch band method.
- Apply chance constrained algorithm and solve stochastic linear programme.
- Formulate GP model and solve it.
- Solve given optimization problem by genetic algorithm or simulated annealing or PSO.

UNIT-I:

UNIT-II:

UNIT-III:

UNIT-IV:
Integer Programming: Introduction – formulation – Geometry cutting plane algorithm – Zero or one algorithm, branch and bound method
**Stochastic Programming:** Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

**UNIT-V:**
**Geometric Programming:** Posynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P (≤ type only)

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

**Text Books:**
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

**Reference Books:**
1. Operations Research by S.D.Sharma
2. Operation Research by H.A.Taha, TMH
3. Optimization in operations research by R.L.Rardin
5. Optimization Techniques theory and practice by M.C.Joshi, K.M.Moudgalya, Narosa Publications
FLXIBLE MANUFACTURING SYSTEMS
(Core-6)

M.Tech. (AMS) (FT)–II Sem

COURSE OBJECTIVES:
- To Understand the role of Flexible Manufacturing Systems (FMS) in manufacturing
- To Understand the concept of Group Technology
- To Understand the concept of Cellular Mfg Systems
- To Understand the benefits of automation
- To Know types of manufacturing industries
- To have a basic knowledge of automation equipment
- To Understand logic control and associated technologies

COURSE OUTCOMES: At the end of the course, the student shall be able to:
- Develop FMS using the most appropriate technique.
- Implement FMS concept in a manufacturing environment
- Use various types of sensors and actuators in PLC implementations
- Explain the role of automation in manufacturing
- Tell the difference between Group Technology and Cellular Manufacturing
- Classify automation equipment and assembly systems into different categories.

UNIT-I:
Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type

UNIT-II:
Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.

UNIT-III:
Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/Deburring station

UNIT-IV:
Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS) Management technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS

UNIT-V:
Design of FMS: Performance Evaluation of FMS, Analytical model and Simulation model of FMS Case studies: Typical FMS problems from research papers

Text Books:

Reference Books:
TOTAL QUALITY MANAGEMENT
(Programme Elective – III)

M.Tech. (AMS) (FT) –II Sem

Prerequisites: Probability and Statistics, Basics of Industrial Engineering

Course Objectives:
The objectives of this course is to introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

Course Outcomes:
After completing this course, students should be able to:

- To know business excellence models and be able assess organization’s performance making reference to their criteria
- To know the principles of total quality management and peculiarities of their implementation
- To be able to use quality management methods analyzing and solving problems of organization
- To know prerequisites of evolution of total quality management and significance of quality gurus’ works to the management of modern organizations.
- To communicate why Total Quality Management (TQM) is fundamental to partnering for mutual benefit.

UNIT-I:
Introduction: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT-II:
Customer Focus and Satisfaction: Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT-III:
Organizing for TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, Ishikawa diagram, paneto diagram; Kepner & Tregoe Methodology.

UNIT-IV:
The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT-V:
ISO 9000: Universal Standards of Quality: ISO around the world, The ISO 9000 ANSI/ASQC Q-90. Series Standards, benefits of ISO 9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.
Text Books:
2. P.N. Mukherjee, PHI publications.

Reference Books:
1. Beyond TQM by Robert L. Flood
2. Statistical Quality Control by E.L. Grant.
PRODUCT DESIGN AND DEVELOPMENT
(Programme Elective - III)

M.Tech. (AMS) (FT)–II Sem

Prerequisites: Management Science

Course Objectives:
- Competence with a set of tools and methods for product design and development.
- Confidence in own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
- Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.
- Enhanced team working skills.

Course Outcomes:
- After doing this course, the student should be able to understand the need of Industrial Product & Development, customer needs & Design aspects of new products.
- Able to involve customer into the development of new products and managing requirements
- Able to understand the design of experiments and technical analysis
- Know product architecture
- Investigate the customer requirement and survey of problems
- Design for manufacture and do prototyping

UNIT-I:

UNIT-II:

UNIT-III:
Industrial design: Assessing the need for industrial design, impact – design process Integrate design process – assessing the quality of industrial design. ROBUST DESIGN-introduction, various steps in robust design.

UNIT-IV:
UNIT-V:

**Design for manufacturing:** Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – cost of supporting production. Minimizing System complexity.

**Prototyping:** Prototype basics – Principles of prototyping – planning for prototypes – Economic analysis. Understanding and representing tasks – baseline project planning – accelerating the project execution.

**Text Books:**

**Reference Books:**
ADDITIVE MANUFACTURING
(Programme Elective-III)

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

Course Objectives: The objective of the Course is to study methods used in additive manufacturing, theories governing the additive manufacturing, give information on materials, explain relations between materials to be processed and methods of additive manufacturing with introduction to common machines used for the technology and show applications and business opportunities with future directions.

Course outcomes:
- Understand the fundamentals for additive manufacturing and how it is different and discuss about various types of liquid based, solid based and powder based AM technologies.
- Understand the various types of Pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software’s used in AM.
- Know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields.

UNIT–I:

UNIT–II:

UNIT–III:

**UNIT–IV:**
**AM Software’s**: Need for AM software, Features of various AM software’s like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.

**UNIT–V:**

**Text Books**:  

**Reference Books**:  
ADVANCED FINITE ELEMENT ANALYSIS
(Programme Elective - IV)

M.Tech. (AMS) (FT)–II Sem

Prerequisite: Fundamentals of finite element analysis

Course Objectives: The objective of this course is to learn advanced topics in FEM so that this tool can be used for analysis, design, and optimization of engineering systems

Course Outcomes: At the end of the course, the student will be able to:
- Understand the Finite Element Formulation procedure for structural Problems.
- Understand the representation and assembly considerations for Beam and Frame elements.
- Analyze Plane stress, Plane strain, axi-symmetric Problems.
- Formulate and solve simple heat transfer and fluid mechanics problems
- Identify significant applications of FEM in Manufacturing.

UNIT-I:

UNIT-II:

UNIT-III:

UNIT-IV: Nonlinear bending of beams, plates and shells: Basic Linear, beam, plate and shell elements, nonlinear plates and shells, time – dependent deformation of shells.

UNIT-V:

Text Books:

Reference Books:
QUALITY ENGINEERING IN MANUFACTURING  
( Programme Elective – IV )

M.Tech. (AMS) (FT) – II Sem

Prerequisites: Metrology and machine tools

Course Objectives:
- To Learn an application of scientific thinking to study the real world industry problems.
- To Understand, conduct and analyze comparative experiments.
- To Understand and apply control charts for analysis of observational data.
- To Design and conduct screening experiments, including graphical analysis.
- To Design, conduct and analyze complete factorial experiments using numerical and graphical methods.
- To Select fractional factorial experiment designs and conduct and analyze them.

Course Outcomes: At the end of the course, the student is able to:\n- To get knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices.

UNIT- I:

UNIT- II:

UNIT- III:

UNIT- IV:
UNIT V:
QUALITY MANAGEMENT SYSTEM AND CONTINUOUS IMPROVEMENT


Text Books:

Reference Books:
APPLIED TRIBOLOGY
(Programme Elective – IV)

M.Tech. (AMS) (FT)–II Sem

Prerequisite: Design of machine members, Fluid Mechanics

Course Objectives:
- To Explain the processes of lubrication in all regimes
- To Explain the friction phenomena
- To Select a suitable lubricant for a specific application
- To Select a suitable material combination for tribological contacts
- To Determine the risk of wear by using simple analyses
- To Suggest an explanation to the cause of a tribological failure

Course outcomes: After completing this course, the student should be able to
- Understand the different types of lubrications and relevant theories used in supporting elements.
- Understand the failure mechanisms in different types of supporting elements.

UNIT–I:
Selection of rolling element bearings: Nominal life, static and dynamic capacity - Equivalent load, probabilities of survival - cubic mean load - bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

UNIT–II:

UNIT–III:

UNIT–IV:
Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.
Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants - additives - lubrication systems and their selection – selection of pump, filters, piping design - oil changing and oil conservation.

UNIT–V:
Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography. Factors to be considered for life enhancement.

Text Books:
References Books:
ADVANCED MANUFACTURING PROCESSES AND SYSTEMS LAB  
(Core Lab – III)

M.Tech. (AMS) (FT)–II Sem

Note: Conduct any Ten exercises from the list given below:

1. Write a program at the machine or off line. Setup the machining operation and perform standards given on lathe operations to develop a simple part (with linear and circular interpolations).

2. The bolt made of AlMg1 is to be made on a CNC lathe in higher batch quantity. Prepare the manufacturing process with the MTS CNC Simulator including following steps: define work part zero, set up the processing sequence, determine tools, fixtures and technological data; generate, set up, test and correct the program at the CNC simulator. A bolt with an external diameter of $\varnothing 100$ mm and the length of 93 mm is to be clamped for the test.

3. The jig plate is to be produced on a CNC vertical milling machine from a blank of Al-alloy dimensioned 100 x 100 x 50 mm. Prepare the production on the CNC Simulator, work out the process layout and set-up form.

4. The contour plate is to be produced on a CNC vertical milling machine from a blank of Al-alloy dimensioned 100 x 70 x 25 mm. Prepare the production on the MTS CNC Simulator, work out the process layout and set-up form.

5. Write a program to perform taper turning operations on Al-alloy work piece of 40mm dia.

6. Write a program to perform thread cutting operations on Al-alloy work piece of 40mm dia.

7. Write a program to perform rectangular and circular grooves on Al-alloy work piece using CNC milling machine.

8. Eriction / Ericson cup test.

9. Deep drawing of cups


12. Metal cutting operations using EDM / ECM performance evaluation.

MATERIAL TESTING AND EVALUATION LAB
(Core Lab - IV)

M.Tech. (AMS) (FT)–II Sem

(Any twelve experiments are to be conducted)

1. Determination of tensile strength of PMC / MMC
2. Determination of flexural strength of PMC/MMC
3. Determination of wear characteristics of PMC / MMC
4. Determination of fracture toughness of MMC using fatigue test
5. Study of fracture surface of different materials tested under UTM, fatigue test
6. Determination of Hardness of PMC/MMC using micro hardness testing machine
7. Determination of thermal conductivity of PMC / MMC
8. Preparation of nano powders using ball mill
9. Determination of water absorption in PMC.
10. Synthesis of a polymer composite
11. Synthesis of a semiconductor nano-particles by chemical method
12. Preparation of metal oxide semiconductor thin film
13. Determination of optical absorption characteristics
14. Electrical transport properties of polymer composite
15. Electrical transport properties of thin film
16. Determination of thermal stability of polymer composite
17. Structural characterization of nano-materials by XRD technique
18. Evaluation of the performance of material systems using the relationship between structure, properties and processing.
VALUE EDUCATION
(Audit Course-II)

M.Tech. (AMS) (FT) – II Sem

Course Objectives
Students will be able to
1. Understand value of education and self-development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outcomes
Students will be able to
1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Syllabus

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<th>Unit</th>
<th>Content</th>
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| 1.   | • Values and self-development-Social values and individual attitudes. Work ethics, Indian vision of humanism.  
      • Moral and non-moral valuation. Standards and principles | 4 |
|      | • Value judgements | |
| 2.   | • Importance of cultivation of values.  
      • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.  
      • Honesty, Humanity. Power of faith, National Unity.  
      • Patriotism. Love for nature, Discipline | 6 |
| 3.   | • Personality and Behavior Development – Soul and Scientific attitude. Positive Thinking. Integrity and discipline.  
      • Punctuality, Love and Kindness.  
      • Avoid fault Thinking.  
      • Free from anger, Dignity of labour.  
      • Universal brotherhood and religious tolerance.  
      • True friendship.  
      • Happiness Vs suffering, love for truth.  
      • Aware of Self-destructive habits.  
      • Association and Cooperation.  
      • Doing best for saving nature | 6 |
| 4.   | • Character and Competence-Holy books vs Blind faith  
      • Self-management and Good health.  
      • Science of reincarnation.  
      • Equality, Nonviolence, Humility, Role of Women.  
      • All religions and same message.  
      • Mind your Mind, Self-control.  
      • Honesty, Studying effectively | 6 |

Suggested reading
CONCURRENT ENGINEERING
(Programme Elective-V)

M.Tech. (AMS) (FT) – III Sem

**Prerequisites:** Computer-Aided Design

**Course objective:** To provide a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support.

**Course Outcomes:**
- Understand the need of concurrent engineering and strategic approaches for product design.
- Apply concurrent design principles to product design.
- Design assembly workstation using concepts of simultaneous engineering.
- Design automated fabricated systems – Case studies.

**UNIT-I:**

- **Introduction:** Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development
- **Use Of Information Technology:** IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

**UNIT-II:**

- **Design Stage:** Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design.
- Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

**UNIT-III:**

- **Manufacturing Concepts and Analysis:** Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative, physical approach - An intelligent design for manufacturing system.

**UNIT-IV:**

- **JIT system:** low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.
- **Project Management:** Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost.

**UNIT-V:**

- Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

**Text Books:**

**Reference Books:**
DESIGN FOR MANUFACTURING AND ASSEMBLY.
(Programme Elective-V)

M.Tech. (AMS) (FT)–III Sem

Prerequisites: Manufacturing Processes, Engineering Materials

Course Objectives: The objective of the course is to identify the manufacturing constraints that influence the design of parts and part systems. Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.

Course Outcomes: At the end of the course, the student will be able to:
- Understand the quality aspects of design for manufacture and assembly
- Apply Boothroyd method of DFM for product design and assembly
- Apply the concept of DFM for casting, welding, forming and assembly
- Identify the design factors and processes as per customer specifications
- Apply the DFM method for a given product

UNIT-I:
Introduction: Design philosophy – Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design.

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 – Use of Solidification Simulation in casting design – Product design rules for sand casting.

UNIT-III:
FORGING – Design factors for Forging – Closed die forging design – Location of parting lines of dies – Drop forging die design – General design recommendations

UNIT-IV:

UNIT-V:
DESIGN FOR ASSEMBLY: General design guidelines for Manual Assembly- Development of 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- Effect of symmetry , Further design guidelines.
**Text Books:**

**Reference Books:**
MANUFACTURING SYSTEMS, SIMULATION MODELLING AND ANALYSIS
(Programme Elective-V)

M.Tech. (AMS) (FT) –III Sem

Prerequisites: Operations Research, Optimization Techniques and Applications and Probability Statistics

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

Course Outcomes:
At the end of course, student should able to
1. Define the state of system W.R.T specified performance measures.
2. Identify Dynamic Discrete- event stochastic system.
3. Develop simulation model for the said system
4. Analyze the model and present the results to specified confidence level.

UNIT - I:

UNIT - II:

UNIT - III:

UNIT - IV:
Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

UNIT –V:
Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – New boy paper problem.
Text Books:

Reference Books:
ADVANCED CASTING AND WELDING TECHNOLOGY
(Open Elective)

M.Tech. (AMS) (FT)–III Sem

Prerequisites: Production Technology, Heat transfer, FEM.

Course Objectives:
- To impart the knowledge of advanced welding and casting techniques.
- To apply computer aided engineering to welding and casting.

Course Outcomes: Student will be in a position to analyze the advanced welding and casting processes and can relate variables with performance measures.

UNIT–I:
Laser Beam Welding: Types of lasers, equipment, power calculation, applications, dual laser beam welding, use of fibre optics in LBW.
Friction Stir Welding: Details of process and process parameters, specific applications.
Electron Beam Welding: The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies.
Ultrasonic Welding: Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies, cutting and gauging, flame cutting, plasma arc welding, laser assisted cutting.

UNIT–II:

UNIT–III:
Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity flow - pressure casting, directional and mono crystal solidification, squeeze casting, semisolid metal casting, rheo-casting.

UNIT–IV:
Solidification, Gating and Rising, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and riser design calculations, Fluidity and its measurement.

UNIT–V:

Text Books:

Reference Books:
ADVANCED ROBOTICS
(Open Elective)

M.Tech. (AMS) (FT) – III Sem

Prerequisites: Kinematics of machinery

Course Objectives:

- To Demonstrate knowledge of different types of actuators used in robotic systems.
- To Analyze the position and velocity kinematics of a robot arm, implement in 2D.
- To Analyze the dynamics of a robot arm, implement in 2D.
- To Analyze sensor signals to implement real-time control algorithms.
- To Demonstrate knowledge of error propagation in electrical, mechanical and computational systems.
- To Construct, program, and test the operation of a robotic system to perform a specified task.

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

- Understand the evolution, classification, structures and drives for robots.
- Teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.
- Expose the students to build a robot for any type of application.

UNIT-I:

Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

UNIT-II:
Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

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

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

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

UNIT-IV:
Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations.

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

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


Text Books:
1. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
2. Industrial robotics by Mikell P. Groover, McGraw Hill.

Reference Books:
1. Industrial robotics by Mikell P.Groover, McGraw Hill
2. Robotics by K.S.Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons