M. TECH. MECHANICAL ENGINEERING (CAD/CAM) (1st Year)

Total Contact Hours = 24 Total Marks = 600 Total Credits = 22

SEMESTER 1st		Contact Hrs			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
MREM0-101	Research Methodology	4	0	0	40	60	100	4
MMEE1-102	Computer Aided Design	4	0	0	40	60	100	4
MMEE1-103	Robotics	4	0	0	40	60	100	4
MMEE1-104	Mechatronics	4	0	0	40	60	100	4
MMEE1-105	Lab -I	0	0	4	60	40	100	2
Departmental Elective – I (Select any one)		4	0	0	40	60	100	4
MMEE1-156	Management Information System							
MMEE1-157	Modern Control of Dynamic Systems							
MMEE1-158	Total Quality Management							
Total	**Theory = 5 Lab = 1**	**20**	**0**	**4**	**260**	**340**	**600**	**22**

Total Contact Hours = 24 Total Marks = 550 Total Credits = 22

SEMESTER 2nd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MMEE1-205	Computer Integrated Manufacturing	4	0	0	40	60	100	4
MMEE1-206	3D - Printing	4	0	0	40	60	100	4
MMEE1-207	Finite Element Modelling (FEM)	4	0	0	40	60	100	4
MMEE1-208	Micro-Electro Mechanical Systems (MEMS)	4	0	0	40	60	100	4
MMEE1-209	Lab-II	-	-	4	60	40	100	2
Departmental Elective – II (Select any one)		4	0	0	40	60	100	4
MMEE1-259	Geometrical Modelling & Analysis							
MMEE1-260	Artificial Intelligence							
MMEE1-261	Welding Technology and Processes							
Total	**Theory = 5 Lab = 1**	**20**	**0**	**4**	**260**	**340**	**600**	**22**

Overall

Semester	Marks	Credits
1st	600	22
2nd	600	22
Total	**1200**	**44**

RESEARCH METHODOLOGY

Subject Code – MREM0-101 **L T P C** **Duration – 45 Hours**
4 0 0 4

UNIT–I (11 Hrs)

Introduction to Research: Meaning, Definition, Objective and Process

Research Design: Meaning, Types - Historical, Descriptive, Exploratory and Experimental

Research Problem: Necessity of Defined Problem, Problem Formulation, Understanding of Problem, Review of Literature

Design of Experiment: Basic Principal of Experimental Design, Randomized Block, Completely Randomized Block, Latin Square, Factorial Design.

Hypothesis: Types, Formulation of Hypothesis, Feasibility, Preparation and Presentation of Research Proposal

UNIT–II (10 Hrs)

Sources of Data: Primary and Secondary, Validation of Data

Data Collection Methods: Questionnaire Designing, Construction

Sampling Design & Techniques – Probability Sampling and Non Probability Sampling

Scaling Techniques: Meaning & Types

Reliability: Test – Retest Reliability, Alternative Form Reliability, Internal Comparison Reliability and Scorer Reliability

Validity: Content Validity, Criterion Related Validity and Construct Validity

UNIT–III (13 Hrs)

Data Process Operations: Editing, Sorting, Coding, Classification and Tabulation

Analysis of Data: Statistical Measure and Their Significance, Central Tendency, Dispersion, Correlation: Linear and Partial, Regression: Simple and Multiple Regression, Skewness, Time series Analysis, Index Number

Testing of Hypothesis: T-test, Z- test, Chi Square, F-test, ANOVA

UNIT – IV (11 Hrs)

Multivariate Analysis: Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Multi-Dimensional Scaling

Report Writing: Essentials of Report Writing, Report Format

Statistical Software: Application of Statistical Softwares like SPSS, MS Excel, Mini Tab or MATLAB Software in Data Analysis

**Each Student has to Prepare Mini Research Project on Topic/ Area of their Choice and Make Presentation. The Report Should Consists of Applications of Tests and Techniques Mentioned in The Above UNITs*

Recommended Books

1. R.I. Levin and D.S. Rubin, 'Statistics for Management', 7th Edn., Pearson Education, New Delhi.
2. N.K. Malhotra, 'Marketing Research–An Applied Orientation', 4th Edn., Pearson Education, New Delhi.
3. Donald Cooper, 'Business Research Methods', Tata McGraw Hill, New Delhi.
4. Sadhu Singh, 'Research Methodology in Social Sciences', Himalaya Publishers.
5. Darren George & Paul Mallery, 'SPSS for Windows Step by Step', Pearson Education, New Delhi.
6. C.R. Kothari, 'Research Methodology Methods & Techniques', 2nd Edn., New Age International Publishers.

COMPUTER AIDED DESIGN

Subject Code: MMEE1-102 **L T P C** **DURATION: 40 Hrs**
4 0 0 4

UNIT-I (6 Hrs)

Introduction: Design process in general and using computers, hardware and software in CAD applications

UNIT-II (12 Hrs)

Two Dimensional Transformations: Two dimensional geometric transformations-basic transformations, concatenation, reflection, shear and transformations between coordinate systems. Two and Three Dimensional Object Representations Parametric representation of synthetic curves, spline representations, cubic spline interpolation methods, Bezier curves and surfaces, B spline curves and surfaces, conversion between spline representations

UNIT-III (10 Hrs)

Representation of Solids: Half spaces, boundary representation (B-rep), sweep representation, constructive solid geometry (CGS), solid manipulations. Three Dimensional Geometric Transformations: Transformations-translation, rotation, scaling, reflections, shears, concatenation transformations.

UNIT-IV (12 Hrs)

Basic concepts of visual realization, hidden line removal, hidden surface removal, shading surfaces and solids, CAD Standards, CAD and CAM integration, Introduction to reverse engineering and rapid prototyping**,** Practice on available CAD packages, computer programming for geometric modelling of curves, surfaces & solids, projects involving assembly and kinematics analysis of mechanisms, surface modeling in any available CAD package.

Recommended Books

1. Groover and Zimmer, CAD/CAM, Prentice Hall.
2. I. Zeid, 'CAD/CAM: Theory and Practice', McGraw Hill.
3. M.E. M, 'Geometric Modeling'.

ROBOTICS

Subject Code: MMEE1-103 **L T P C** **DURATION: 40 Hrs**
4 0 0 4

UNIT-I (5 Hrs)

Introduction: A sense of history, a sense of design, manipulators and manipulations, robot analysis and control in a nutshell.

UNIT-II (12 Hrs)

Kinematics I: **Geometry**: Mathematics preliminary, position and orientation of a rigid body, co-ordinate transformation, Euler angle, homogeneous transformations. Kinematics modeling of manipulator arms, open kinematic chains, the denairt-Hartenberg notation, kinematics equations. Inverse kinematics: introduction, solving the kinematic equation for the 5 RIP manipulators, solvability. Kinematics II: Differential Motion Kinematic modeling of instantaneous motions, differential relations, infinitesimal relations, computation of the manipulators, Jacobian, inverse instantaneous

UNIT-III (14 Hrs)

Kinematics: Resolved motion rate, redundancy, optimal solutions. Static's Force and moment analysis, equivalent joint torques, duality, transformations of force and moments. Stiffness, introduction, endpoint compliance analysis, the principal transformation of compliance matrices.

Dynamics: Newton-Euler formulation of equation of motion, basic dynamic equation, closed form Dynamic equations, physical interpretation of the dynamic equation. Longrangian Formulation of the manipulator dynamics, LaGrange dynamics, the manipulators inertia tensor, deriving LaGrange motion equation, transformations of generalized co-ordinates. Inverse dynamics; introduction, recursive computation, moving co-ordinates, walker Paul's algorithm.

UNIT-IV (8 Hrs)

Trajectory Control: Introduction, position control, load scheme work, trajectory control, sliding surfaces, Perfect tracking using switched control laws, continuous control law to approximate switched control. robust trajectory control for robot manipulators, practical evaluation of parametric uncertainties, the modeling/performance trade-off.

Recommended Books

1. J. Baillieul, D.P. Martin, R.W. Brockett, Bruce R. Donald Robotics.

2. Ben-Zion Sandler Robotics: Designing the Mechanisms for Automated Machinery.
3. Michael Jenkin, Gregory Dudek, Computational Principles of Mobile Robotics.
4. R. Bruce, Error Detection and Recovery in Robotics Donald – Technology.
5. Craig Sayers, Remote Control Robotics.
6. Y. Shimon, Handbook of Industrial Robotics.

MECHATRONICS

Subject Code: MMEE1-157 **L T P C** **4 0 0 4** **Duration - 50** Hrs.

UNIT-I (6 Hrs)

Control Engineering: Open loop and closed loop control system, system components, hydraulic, thermal, pneumatic processes and their electrical analogies.

UNIT-II (15 Hrs)

Process Control: Concept of measurement of electrical and non-electrical parameters, displacement, force, temperature, pressure etc. and related signal conditioning techniques. Valves, drives and actuators, PID controllers, multivariable and multi-loop processes, basic circuits using pneumatic and PLC's.

UNIT-III (6 Hrs)

Sensors and Signal Conditioners: Transducers for Industrial processes, signal conditioning, output devices and displays.

UNIT-IV (13 Hrs)

Microprocessors and Interfacing: Microprocessors/ Microcontroller architecture and programming memory, Input/output operations and interfacing, peripherals, typical applications of Microprocessors, system design concept through case studies.

Recommended Books

1. Koren, 'Computer Control of Manufacturing System', McGraw Hill.
2. Groover, 'Production Systems and CIM', PHI.
3. Maleki, 'Flexible Manufacturing Systems', Prentice Hall.
4. B.C. Kuo, 'Feedback Control Systems', PHI.
5. E.O. Doeblin, 'Measurement Systems', McGraw Hill.

MANAGEMENT INFORMATION SYSTEM

Subject Code: MMEE1-156 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (12 Hrs)

Information Systems: Information Systems -Establishing the Framework -Business Models - Information System Architecture- Evolution of formation Systems, Modern Information System**,** Modern Information System -Systems Development-life Cycle, Structured Methodologies - Designing Computer Based methods, Procedures Control Designing Structured Programs.

UNIT-II (12 Hrs)

Integrated Construction Management: Integrated Construction Management- Information System- Project Management- Information System- Functional Areas finance, Marketing Production, Personnel –levels, DSS, EIS, ES- Comparison Concepts and Knowledge representation –Managing International Information System

UNIT-III (9 Hrs)

Coding Techniques: Control -Testing Security- Coding Techniques- Defection of Error – Validating -Cost Benefit Analysis -Assessing the value and risk of Information System.

UNIT-IV (12 Hrs)

Software Engineering: Software engineering qualities- Design-Production- Service, Software specification- Software Metrics, Software quality assurance –Systems Methodology –Objectives-Time and Logic, Knowledge and Human Dimension -Software life cycle models- Verification and Validation. 27 CEM-2013 SRM(E&T)

Recommended Books

1. O. Brian, ‘Introduction to Information System’, McGraw Hill.
2. O.Brian, ‘Management Information System’, TMH.
3. Alter, ‘Information Systems: A Management Perspective’, Addison Wesley.
4. Arora & Bhatia, ‘Information Systems for Managers’, Excel.
5. Bansal, ‘Information System Analysis & Design’, TMH.
6. Jawadegar, ‘Management Information System’, TMH.
7. Murdick, ‘Information System for Modern Management’, PHI.
8. Alexis Leon, ‘Enterprise Resource Planning’, TMH.

MODERN CONTROL OF DYNAMIC SYSTEMS

Subject Code: MMEE1-157 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-I (5 Hrs)

Introduction: Introduction to control system, Feedback and feedforward systems, design of control systems, classification of control systems.

UNIT-II (13 Hrs)

Classical Control: Poles and zeros, Singularity functions, Frequency response, Laplace transform, transfer functions, Performance specifications, Stability of linear systems, Necessary conditions for stability, Root locus techniques, Bode plots, Nyquist plots, Routh Stability criterion, Polar plots, Robustness, Closed-loop compensation for SISO systems.

UNIT-III (12 Hrs)

State-Space Representation: State variables and state models, Linear transformation for state-space representation, State models for linear continuous time systems, System characteristics, Canonical forms, Solution of the LTI state equations, State transition matrix.

UNIT-IV (15 Hrs)

Control System Design in State-Space: Controllability, Observability, State feedback regulators, Pole-placement regulator design, Pole-placement design of tracking systems, Full order observer design, Design of compensators. Linear Optimal Control Optimal control problem, Infinite-time linear optimal regulator design, Optimal control of tracking systems, Output weighted linear optimal control, Solution of the Matrix Riccati Equation.

Recommended Books

1. A. Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley and Sons, **2002**.
2. K. Ogata, 'Modern Control Engineering', Prentice Hall of India Pvt. Ltd., **2010**.
3. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, **2006**.
4. B.C. Kuo, 'Digital Control Systems', Oxford University Press, **2006**.
5. C. Richard Dorf and H. Bishop Robert, 'Modern Control Systems', Pearson, **2011**.

TOTAL QUALITY MANAGEMENT (TQM)

Subject Code: MMEE1-158 **L T P C** **Duration: 44 Hrs.**
4 0 0 4

UNIT-I (8 Hrs)

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type. Control on Purchased Product

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

UNIT-II (12 Hrs)

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims. Quality Management, Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

UNIT-III (12 Hrs)

Human Factor in Quality: Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods. Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.

Attributes of Control Charts: Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart

UNIT-IV (12 Hrs)

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

IS0-9000 and its concept of Quality Management: ISO 9000 series, Taguchi method, JIT in some details

Recommended Books

1. Lt. Gen. H. LaI, 'Total Quality Management', Wiley Eastern Limited, **1990**.
2. Greg Bounds, 'Beyond Total Quality Management', McGraw Hill, **1994**.
3. H.G. Menon, 'TQM in New Product Manufacturing', McGraw Hill.

COMPUTER INTEGRATED MANUFACTURING

Subject Code: MMEE1-205 **L T P C** **Duration: 40 Hrs**
4 0 0 4

UNIT-I (10 Hrs)

Introduction: Introduction to Product life cycle management. Need of CAD/CAM integration through computers, Benefits of integration, Types of production systems and their automation, CAD/CAM integration. Concept of FMS and CIMS. DNC based factory management and control, Integrated CAD/CAM system and shared database.

UNIT-II (11 Hrs)

Elements of a General CIM System: Types of CIM systems, CAD-CAM link for CIMS, Benefits of CAM, FMS and CIMS, Automated material handling systems, equipment and their functions. Integration of Robots in CIMS, automated guided vehicle navigation system, Automatic Storage and Retrieval Systems (AS/RS), Carousel storage system, design of automatic material handling system, KWO analysis, work-part transfer mechanisms.

UNIT-III (09 Hrs)

Group Technology: Concept and terminology, Part family formation, Classification and coding systems for components, Group technology machine cells.

UNIT-IV (10 Hrs)

Computer Aided Production Planning and Control: Computer aided shop floor control, Computer aided inspection & quality control, Shop floor data collection systems, Sensors used in Automation, Tool management system, Automatic identification systems, Barcode system.

CIM Database and Database Management Systems: Types, Management information system, Manufacturing data preparation.

Recommended Books

1. M.P. Groover and E.W. Zimmers, 'CAD/ CAM', Dorling Kingsley, **2008.**
2. M.P. Groover, 'Automation, Production Systems and Computer Integrated Manufacturing', Pearson Education Asia, **2009.**
3. K.S. Vajpayee, 'Principles of Computer Integrated Manufacturing', Prentice Hall, **2006.**
4. P.N. Rao, N.K. Tewari and T.K. Kundra, 'Computer Integrated Manufacturing', McGraw Hill, **1998.**

FINITE ELEMENT MODELLING (FEM)

Subject Code: MMEE1-207 **L T P C** **Duration: 45 Hrs**

4 0 0 4

UNIT-I (11 Hrs)

Approximate Solution Methods: Finite Difference Method, Finite Element Methods, Ritz and Rayleigh Ritz methods, Method of weighed residuals, General concepts, Point collocation, Subdomain collocation, least squares, Galerkin method.

UNIT-II (12 Hrs)

Introduction to Finite Element Method: Introduction to variational calculus, The differential of a function, Euler-Lagrange equation, Geometric & natural boundary conditions, Basic Concept of Finite Element Method, Principle of potential energy, 1D elements, Derivation of Stiffness and

Mass matrices for a bar, A beam and A shaft, Comparison with Analytical results, Interpolation and shape functions,

UNIT-III (12 Hrs)

Solution of static problems and case studies in stress analysis of mechanical components, FEA using 2D and 3D elements, Plain strain and plain stress problems, FE using plates / shell elements, analysis using Isoparametric Elements. Programming of the different concepts covered in lectures using C++/MATLAB language, demonstration of analysis software for finite element analysis.

UNIT-IV (10 Hrs)

Students will be given different 2D /3D components for structural/thermal/ fluid flow FEM analysis to be done using C++/MATLAB programming. The components are to be analyzed using different linear / higher order elements i.e., triangular, axisymmetric, quadrilateral, tetrahedral and hexahedral elements.

Recommended Books

1. O.C. Zienkiewicz, 'The Finite Element Method', Butterworth Heinemann, **2002.**
2. K.H. Huebner, D.L. Dewhirst, D.E. Smith and T.G. Byrom, 'The Finite Element Methods for Engineers', John Wiley, **2000.**
3. J.N. Reddy, 'An Introduction to the Finite Element Method', McGraw Hill, **2001.**
4. K.J. Bathe, 'Finite Element Procedures', Prentice Hall of India, **2008.**
5. R.D. Cook, 'Concepts and Applications of Finite Element Analysis', John Wiley and Sons, **2001.**
6. G.R. Buchman, 'Finite Element Analysis', Schaum's Outlines, McGraw Hill, **1995.**

MICRO-ELECTRO MECHANICAL SYSTEMS (MEMS)

Subject Code: MMEE1-208 **L T P C** **Duration: 44 Hrs**

4 0 0 4

UNIT-I (10 Hrs)

Overview of MEMS and microsystems, microelectronics, microfabrication, miniaturization, typical MEMS and microsystems products

UNIT-II (11 Hrs)

Working Principles of Microsystems: microsensors, microactuation, MEMS with microactuators, microfluidics, microvalves, micropumps, micro-heatpipes.

Overview of materials for MEMS and microsystems: atomic structure of matter, ions and ionization, doping of semiconductors, diffusion process, electrochemistry.

UNIT-III (11 Hrs)

Microsystem Fabrication: photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, sputtering, etching.

Micromanufacturing: bulk micromanufacturing, surface micromanufacturing, LIGA process.

UNIT-IV (12 Hrs)

Assembly, Packaging and Testing of Microsystems: overview of microassembly, microassembly processes, major technical problems of microassembly, microsystem packaging and its levels, essential packaging technologies, reliability and testing in MEMS packaging.

Recommended Books

1. Tai-Ran Hsu, 'MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering', John Wiley & Sons, Inc.
2. N.P. Mahalik, 'Micro manufacturing and Nanotechnology', Springer.
3. Nadim Maluf, Kirt Williams, 'An Introduction to Microelectromechanical Systems Engineering', Artech House, Inc.
4. Mark Ratner, Danier Ratner, 'Nanotechnology', Pearson Education Inc.
5. Charles P. Poole Jr. & Frank J. Owens, 'Introduction to Nanotechnology', John Wiley & Sons.

LAB-II

Subject Code: MMEE1-209 **L T P C**
0 0 4 2

One lab /field/industrial oriented project /problem will be allocated to each student related to the subjects related to the subjects taught in 2nd Semester.

GEOMETRICAL MODELLING & ANALYSIS

Subject Code: MMEE1-259 **L T P C** **Duration: 46 Hrs**
4 0 0 4

UNIT-I (12 Hrs)

Geometric Modelling: Parametric sketching, Constrained model dimensioning, Material addition and removal for extruded, Revolved, Swept and blended features, References and construction features of points, Axis, Curves, Planes, Surfaces and customized analysis features, feature and sequence of feature editing. Cosmetic features, Chamfers, Rounds, Standard holes, File formats for data transfer.

UNIT-II (12 Hrs)

Feature Patterns, Duplication, Grouping, Suppression, Assembly modeling, Assembly analysis tools. Top-down vs. bottom-up design, Parametric relations and design optimization parameters creation, Mass property analysis, Automatic production drawing creation and detailing, Software

automation and customization tools, Colors, Advanced features for non-parallel blend, Helical sweep, Swept blend, Variable section sweep, Draft, Ribs, Sketched holes, Mechanism design and assembly.

UNIT-III (11 Hrs)

Mechanical Design Analysis and Optimization: Design analysis for mass properties, Stress, Thermal stress, using CAD/CAE packages, Optimum design of machine components using multivariable nonlinear optimization techniques using iterative CAD/CAE software tools.

UNIT-IV (11 Hrs)

Research Assignments: Individual research assignments will be based on use of standard CAD and CAE packages for modeling of mechanical elements, Assembly and Automated Drawing. Project involving assembly, position, kinematic and dynamic analysis of a mechanism. Interference analysis in motion. Optimization of mechanical system design using CAD/CAE software tools, Project on mechanical systems design and analysis. Make a prototype for design validation.

Recommended Books

1. Kelley David S., 'Pro/ENGINEER Wildfire 5.0 Instructor', Tata McGraw Hill, **2011.**
2. Shih Randy H., 'Introduction to Finite Element Analysis Using Creo Simulate 1.0', SDC Publications, USA, **2011.**
3. Shih Randy H., 'Parametric Modeling with Creo Parametric 1.0-An Introduction to Creo Parametric 1.0', SDC Publications, USA, **2011.**
4. N. Sidheswar, P. Kannaiah and V.V.S. Sastry, 'Machine Drawing', McGraw Hill, **2001.**

ARTIFICIAL INTELLIGENCE

Subject Code: MMEE1-260 **L T P C** **Duration: 45 Hrs**

4 0 0 4

UNIT-I (10 Hrs)

Human and machine intelligence, Artificial Intelligence (AI), Programming in AI environment, Natural Language processing (NLP).

UNIT-II (12 Hrs)

Architecture of an Expert system, Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic. Selection of inference mechanism.

Introduction, to Rule Based System, Conflict Resolution, Advantages and Drawbacks of Rule Based Systems Clausal Form Logic; Rule Base Verification, Refinement and Validation.

UNIT-III (12 Hrs)

Creating Knowledge Base, Knowledge Engineer and Domain Expert, Phases of Knowledge Engineering, Tools for Knowledge Engineering.

Neural network applications, artificial neural network models, NN applications in Cellular manufacturing and other areas of mechanical Engineering.

UNIT-IV (11 Hrs)

Fundamentals of OOP (Object oriented programming), creating structures and objects, object operations, invoking procedures, programming applications, object oriented expert systems.

Semantic nets, structure and objects, ruled systems for semantic nets, certainty factors, automated learning.

Recommended Books

1. T.R. Addis, 'Designing Knowledge Based System', Prentice Hall, **1985**.
2. D.W. Rolston, 'Principles of Artificial Intelligence and Expert Systems Development', McGraw Hill, **1988.**
3. R. Maus and J. Keyes, 'Handbook of Expert Systems in Manufacturing' McGraw Hill, **1991.**
4. Robert Levine, 'A Comprehensive Guide to Artificial Intelligence and Expert Systems',
5. Elain Rich, 'Artificial Intelligence'.

WELDING TECHNOLOGY AND PROCESSES

Subject Code: MMEE1-261 **L T P C** **Duration: 45 Hrs**
4 0 0 4

UNIT-I (11 Hrs)

Welding Metallurgy: Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lamellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

UNIT-II (10 Hrs)

Weld Design & Quality Control: Principles of sound weld design, welding joint design, welding defects; Testing of weldament, Material joining characteristics, Welding positions, Allowable strength of welds under steady loads, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.

UNIT-III (12 Hrs)

Modern Trends in Welding: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding. Mechanization in Welding: Mechanization of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanization of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating

tables positioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.

UNIT-IV (12 Hrs)

Robotics in Welding: Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self-alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering, Efficiency of robotics in welding.

Microwelding Technologies: Introduction to Microwelding techniques.

Recommended Books

1. Nikodaco & Shansky, 'Advanced Welding Processes', MIR Publications.
2. V.M. Radhakrishnan, 'Welding Technology and Design', New Age International.
3. M.M. Schwariz, 'Source Book of Innovative Welding Processes', American Society of Metals (Ohio).
4. J. Cornu, 'Advanced Welding Systems', Vol. I, II, III, Jaico Publishers.
5. P.N. Rao, 'Manufacturing Technology (Foundry, Forming and Welding)', Tata McGraw Hill.