Mechanical Engineering Department

Syllabus (Masters of Technology)

With Specialization in Mechanical Engineering

Semester:I

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Theory									
1	MME 101	Stress Analysis	3	1	-	3	30/12	70/28	100/40
2	MME 102	Kinematics and Dynamics of Machines	3	1	-	3	30/12	70/28	100/40
3	MME 103	Machine Design	3	1	-	3	30/12	70/28	100/40
4	MME 104	Machine Tool Design	3	1	-	3	30/12	70/28	100/40
5	MME 105	Stress Analysis Lab	-	-	3	3	40/16	60/24	100/40
		Total	**12**	**4**	**3**				**500**
		Total Teaching Load	**19**						

Semester: II

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Theory									
1	MME 201	Fracture Mechanics	3	1	-	3	30/12	70/28	100/40
2	MME202	Theory of Elasticity	3	1	-	3	30/12	70/28	100/40
3	MME 203	Computer aided Design	3	1	-	3	30/12	70/28	100/40
4	MME 204	Tribology	3	1	-	3	30/12	70/28	100/40
5	MME 205	CAD Lab	-	-	3	3	40/16	60/24	100/40
		Total	**12**	**4**	**3**				**500**
		Total Teaching Load	**19**						

Year: II — Semester: III

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Theory									
1	MPE 301	Materials Management	3	1	-	3	30/12	70/28	100/40
2	MPE 302	Robotics Engineering	3	1	-	3	30/12	70/28	100/40
3	MME 302	Design Lab	-	-	-	-	40/16	60/24	100/40
4	MME 304	Seminar on Advance Topics	-	-	-	-	40/16	60/24	100/40
	MME 305	Dissertation Part – I	-	-	-	-	40/16	60/24	100/40
Total			**6**	**2**	**-**				**500**
Total Teaching Load			**08s**						

Year: II — Semester: IV

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Practical's									
1	MPE 401	Dissertation Part – II	-	-	10	-	250/100	250/100	500/200
Total Teaching Load			**-**	**-**	**10**				**500**

Stress Analysis(MME101)

Strain Measurement, an ideal strain gauge, mechanical, optical, acoustical, pneumatic, dielectric and electrical strain gauges. Differential transformer and piezoelectric transducers. Electrical Wire Resistance Strain Gauges: bonded type gauges, bonding agents, foil gauges, gauge materials. Weldable gauges. Strain gauge adhesive. Fixing of gauges. Temperature effects in bonded gauges. Gauge factor and gauge sensitivity. Measurement of stress and stress gauge. Measuring Circuits and Strain Gauge Rosette: Potentiometer circuit, Wheatstone bridge, circuit sensitivity and out put, temperature compensation and signal addition. Rectangular, delta and tee- delta rosette. Application of strain gauge in practical problems.

Brittle coating, crack pattern and crack detection in coating. Moire Fringe, geometry. Analysis of Photoelasticity Data, polariscope, fringes due to principal stress direction and difference, model making, interpretation of isoclinics and isochromatics and fractional fringe order. Calibration through tension, beam and disc models. Reflection polariscopy. Application to stress concentration and stress intensity factor. Separation of stresses.

Text Book(s):

1. Experimental Stress Analysis, by Abdul Mubeen; Dhanpat Rai and Sons.

2. Experimental Stress Analysis, by JW Dally and WF Riley; McGraw-Hill.

Reference Book(s):

1. The Strain Gage Primer, by CC Perry and HR Lissner; McGraw-Hill.

2. Moire Fringes in Strain Analysis, by PS Theocaris; Pergammon Press.

Kinematics & Dynamics of Machines(MME102)

Friction: Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear,

Belt and pulley drive: Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive.

Brakes & Dynamometers, Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers.

Gears & Gear Trains: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear.

Gyroscopic Motion, Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles

Reference:

1. Kinematics of Machines-Dr. Sadhu singh

2. Mechanics of Machines – V. Ramamurti

3. Theory of Machines – Khurmi & Gupta

4. Theory of Machines – R. K. Bansal

MACHINE DESIGN(MME103)

Introduction: Classification of Machine Design, Considerations in Machine Design, General Procedure in Machine Design, Mass, Weight, Inertia, Laws of Motion, Force, Moment of Force, Couple, Mass Density, Mass Moment of Inertia, Angular Momentum, Toque, Work, Power, Energy: PE, SE, KE. Engineering Materials & their Properties: Classification of Engineering Materials, Selection of Materials for Engineering Purposes, Physical Properties of Metals, Mechanical Properties of Metals, Ferrous Metals, Cast Iron, Types of Cast Iron, Alloy Cast Iron, Effect of Impurities of Cast Iron, Wrought Iron, Steel, Steels Designated on the Basis of Mechanical Properties, Effects of Impurities on Steel, Free Cutting Steels, Alloy Steels, Stainless Steel, Heat Resisting Steels, High Speed Tools Steels, Spring Steels, Heat Treatment of Steels: Normalising, Annealing, Spheroidising, Hardening, Tempering, Surface Hardening or case hardening, Non Ferrous Metals, Non Metallic Materials: Plastics, Rubber, Leather, Ferrodo. Manufacturing Considerations in Machine Design: Manufacturing Processes, Casting, Casting Design, Forging, Forging Design, Mechanical Working of Metals, Hot Working, Cold Working, Types of Fits, Surface Roughness and its Measurement.

Text Book(s):

1. A Textbook of Machine Design by R.S Khurmi, J.K. Gupta

Machine Tool Design(MME104)

Working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, protecting devices for slide-ways, Design of power screws.

Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, Closed loop system, Dynamic characteristics of cutting process, Stability analysis.

Books:

1. Machine Tool Design N.K. Mehta Tata McGraw Hill
2. Machine Tool design Handbook - CMTI Bangalore

Experimental Stress Analysis Lab(MME105)

1. Experiments using strain gauges.
2. Measurement of strain, temperature effects.
3. Fixing of gauges on surfaces.
4. Experiments using photo elastic bench.
5. Setting of polar scope and calibration of disc, beam and tension model.

FRACTURE MECHANICS(MME201)

History of failure by Fracture; failure of structures, bridges, pressure vessels and ships, brittle fracture, development of testing for failure, identification of reasons for failure, existence of crack, Griffith crack and experiment, energy release rate and stress for failure in presence of crack.

Stress Field around Crack Tip; revision of theory of elasticity, conformal mapping, Airy's stress function for crack tip stress field with crack emanating from straight boundary, stress state in crack tip vicinity, modes of crack face deformation, stress intensity factor and Irwin's failure criterion, fracture toughness.

Energy Consideration; potential energy, surface energy, plastic deformation around crack tip, energy release rate, compliance and correlation with fracture toughness, crack opening displacement (COD), COD as fracture criterion, experimental determination of COD, use of fracture toughness and COD as design criteria.

Crack Propagation: law of fatigue crack propagation, life calculation when a crack is present and loaded, microscopic aspects of crack propagation, elastic crack and plastic relaxation at crack tip.

Text Book(s):

1. Elementary Engineering Fracture Mechanics by David and Bruck; Norelco.
2. Fracture and Fatigue Control in Structure by ST Rolfe and JM Barson; Prentice Hall.

Reference Book(s):

1. Fracture Mechanics Fundamentals and Applications by TL Anderson; CRC Press.
2. Fracture of Structural Materials by AS Tetelman and AJ McEvily; John Wiley and sons.
3. Macine Design by Abdul Mubeen; Khanna Publishers.

THEORY OF ELASTICITY(MME202)

State of stress at a point, stress notations, state of strain at a point and notations, states of plane stress and plane strain. Hooke's law and generalized statement of Hooke's law, stress-strain relationships.

Concept of principal stress and strain, Mohr's circle.

Cartesian coordinates, boundary conditions. Problems of cantilever, supported beam under distributed load of uniform and uniformly variable intensity.

Use of Fourier series. Two dimensional elasticity problems in polar coordinates, equation of equilibrium. Axi-symmetric problems, thick cylinder, curved bars. Hole in a plate problem. Idea of an edge dislocation.

Torsion of straight bars, elliptic and circular section. Membrane analogy, torsion of thin rectangular section. Application of energy method to torsion problem. Torsion of thin tubes.

Text Book(s):

1. Theory of Elasticity by SP Timoshenko; McGraw-Hill (International student edition).

Reference Book(s):

1. Applied Elasticity by Zhilun Xu; Wiley Eastern Ltd.

2. Applied Elasticity by Chi-Teh Wang; McGraw-Hill.

COMPUTER AIDED DESIGN(MME203)

Transformation and Manipulation of Objects: Introduction, Transformation Matrix, 2D transformation, Arbitrary Rotation about the origin, Rotation by different angles, Concatenation, 2D transformation, Projection on to a 2D plane, Overall scaling, Rotation about an Arbitrary Point, 2D Reflection, 3D Transformation, 3D scaling, 3D Rotation of Objects, 3D Rotation about an arbitrary Axis, 3D Visualisationreconstruction of Three Dimensional Images.

Bezier Curves, B-Spline Curve, Non Uniform Rational B-Spline(NURBS),

Surface creation, Coons patch, tensor product surfaces, Bezier surface, relational parametric surface, parametric spline surface, Lofted surfaces, spline blended surfaces, Tangent and Twisted vectors, Blended surfaces, Application Software.

Solid Modeling: Introduction, solid models and entities, solid representation, regularized Boolean operation, Half-spaces, B-Rep and CSG modeling techniques, analytic solid modeling, solid manipulations.

Mechanical Assembly analysis: Assembly modeling- parts modeling and representation, Hierarchical relationships, Mating conditions, Representation schemes- Graph structure, location Graph, virtual link, generation of assembly sequences: precedence diagram, liaison sequencing analysis, precedence Graph, assembly analysis.

Text Book(s):

1. CAD/CAM Theory and Practice by Ibrahim-Zeid; Tata McGraw Hill

Reference Book(s):

1. Principles of Computer Aided Design and Manufacturing by Farid Amirouche; Pearson Prentice
Hall.
2. CAD/CAM/CIM by P Radhakrishnan; New Age International.
3. Mathematical Elements of Computer graphics by Rogers and Adams; McGraw Hill
4. Computer Aided Design by Besant and Lui; Prentice Hall.

TRIBOLOGY(MME204)

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation - absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers, Recycling of used oil & oil Conservation. Disposal of scrap oil & oil emulsions. Friction: Introduction, Laws of friction, kinds of friction, causes of friction, friction measurement, theory of friction.

Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

Hydrodynamic theory of lubrication: Various theories of lubrication, Petroffs equation, Reynold's equation in two dimensions. Effects of side leakage - Reynolds equation in three dimensions,

Friction and power losses in journal bearings: Calibration of friction loss friction in concentric bearings, bearing modulus, Summerfield number, heat balance, practical consideration of journal bearing design considerations.

Air lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings, hydrodynamic thrust bearings.

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. Bearing materials: General requirements of bearing materials,

types of bearing materials.

TEXT BOOKS:

1.Fundamentals of Tribology. by- Basu, Sen Gupta and Ahuja, PHI

2.Tribology in Industry by- Srivastava, Sushil Kumar, S. Chand &Co.

REFERENCE BOOKS

1. Theory and Practice of Lubrication for Engineers by- Fuller, D. D., John Wiley and Sons.

2. Principles of Tribology by- Halling J., McMillan Press Ltd.

3. Machine Design by- Abdul Mubeen, Khanna Publishers

4. Tribology by– Majumdar, B.C.

CAD/CAM LAB(MME205)

Section-I

1. Develop a general purpose code to carry out the rotation of an object about an axis through two points.
2. Develop a general purpose code to carry out:
Orthogonal projection, Dimetric projection (given foreshortening factor Fz), Isometric projection, Perspective projection given Zc,
3. Develop a general purpose code, given two arbitrary projections and the respective transformation matrices and the reconstructed coordinates of the vertices of the object.
4. Develop a general purpose code to carry out the reflection of an object about an arbitrary plane passing through three points.

Section-II

1. Develop a general purpose code for integrated:
Cubic spline with differential boundary conditions, Bezier curve, B- spline- Its various types and best fit B-spline.
Given Coordinates of the control points, boundary conditions, order of the curve, if required, and Match the output to projected image of any CAD/CAM package.

MATERIALS MANAGEMENT(MME301)

Introduction: introduction to material management and productivity, functions of material management, organization structures in material management, role of material management techniques in improved material productivity.

Material planning: objectives, material requirement planning, manufacturing resource planning, JIT production planning, strategic material planning, material control: acceptance, sampling, inspection, make or buy decision, simple cost analysis, economic analysis, break even analysis, break even point theory, whether to add or drop a product line store management and warehousing, product explosion. Purchasing: importance of good purchasing system, organization of purchasing functions, purchase policy and procedures, responsibility and limitations, purchasing decisions, purchasing role in new product development, role of purchasing role cost reduction, negotiations and purchase, purchasing research: identification of right sources of supply, vendor rating, standardization, vendor certification plans, vendor and supply reliability, developing new source of supply.

Cost reduction: cost control vs cost reduction, price analysis, material cost reduction techniques, variety reduction, cost reduction and value improvement, techniques of cost control, standard costing, cost effectiveness, cost analysis for material management, material flow cost control. Inventory management, inventory vs stores, types of inventory, inventory control, inventory build-up, EOQ, various inventory models, inventory models with quantity discount, exchange curve concept, coverage analysis, optimal stocking and issuing policies, inventory management of perishable commodities.

Text Book(s):

1. Material management by WR Stelzer Jr; Prentice Hall
2. Material management by DS Ammer & Richard Erwin.

Reference book(s):

1. Material management by AK Dutta; Prentice Hall
2. Material management: An integrated approach by P Gopalakrishnan & M Sundersen; Prentice Hall

ROBOTIC ENGINEERING(MME302)

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,

Kinematics of Robot Manipulator: Introduction, General Description of Robot Manipulator, Mathematical Preliminaries on Vectors & Matrices, Homogenous Representation of Objects, Robotic Manipulator Joint Coordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw (RPY) Transformation, Relative Transformation, Direct & Inverse Kinematics Solution, D H Representation & Displacement Matrices for Standard Configurations, Geometrical Approach to Inverse Kinematics. Homogeneous Robotic Differential Transformation: Introduction, Jacobian Transformation in Robotic Manipulation.

Robotic Workspace & Motion Trajectory: Introduction, General Structures of Robotic Workspaces, Manipulations with n Revolute Joints, Robotic Workspace Performance Index, Extreme Reaches of Robotic Hands, Robotic Task Description. Robotic Motion Trajectory Design - Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories.

Dynamics of Robotic Manipulators: Introduction, Bone, Graph Modeling of Robotic Manipulators, Examples of Bond Graph Dynamic Modeling of Robotic Manipulator. Brief Discussion on Lagrange-Euler (LE) Dynamic Modeling of Robotic Manipulators- Preliminary Definitions, Generalized Robotic Coordinates, Dynamic Constraints, Velocity & Acceleration of Moving Frames, Robotic Mass Distribution & Inertia Tensors, Newton's Equation, Euler Equations, The Lagrangian & Lagrange's Equations. 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, Dynamic Equations of Motion for A General Six Axis Manipulator.

Robot Teaching: Introduction, Various Teaching Methods, Task Programming, survey of Robot LevelProgramming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language

Structure, various Textual Robot Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc.

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors. Industrial Applications: Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

Text Book(s):

1. A Robot Engineering Textbook by Mohsen Shahinpoor; Harper & Row publishers, New York.
2. Robotics, control vision and intelligence by Fu, Lee and Gonzalez; McGraw Hill International.
3. Introduction to Robotics by John J. Craig; Addison Wesley Publishing.
4. Robotics for Engineers by Yoram Koren; McGraw Hill International.
5. Industrial Robotics by Groover, Weiss, Nagel; McGraw Hill International.
6. Robotics and Control by Nagrath-Mittal, TMH

Reference Book(s):

7. Robot Technology Fundamentals by Keramas, Thomson; Vikas Publication House.
8. Company Fundamentals of Robotics Analysis and Control by Schilling; Prentice Hall.
9. Introduction to Robotics by Niku; Pearson Education, Asia.
10. Foundation of Robotics by Yoshikawa; Prentice Hall (EEE).
11. Robotic Engineering - An Integrated approach by Klafter, Chmielewski and Negin; Prentice Hall.
12. Robot Vision and Sensor Controls Vol-3 by Rooks B; North Holland.