THEORY OF MACHINES

Subject Code :15MA42	IA Marks :20
Hours/Week :03L + 2T, No. of Credits:04	Exam Hours :03
Total Hours :52	Exam Marks :80

Course objectives

1. Familiarize with common mechanisms and carryout mobility and motion analysis of mechanisms.
2. Understand gears and analyze gear train.
3. Emphasize the concept of friction and friction drives
4. Understand various cam motion profiles and follower mechanism, analyze cam motions.

Course outcomes

Students will be able

1. To identify mechanisms with basic understanding of motion.
2. To choose the gear trains for a different speed and torque transmission.
3. Assimilate friction and its use in power transmission.
4. Design and evaluate the performance of different cams and followers.

UNIT – 1

Introduction: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

Quick return motion mechanisms - Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. **10 Hours**

UNIT – 2

Velocity and Acceleration Analysis of Mechanisms (Graphical and Analytical Methods): Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism. Mechanism illustrating Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing. **10 Hours**

UNIT – 3

Spur Gears: Gear terminology, law of gearing, Path of contact, Arc of contact, Contact ratio of spur gear. Methods of avoiding interference, Back lash. Comparison of involute and cycloidal teeth. Rack & Pinion

Gear Trains: Simple gear trains, Compound gear trains. Epicyclic gear trains - Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains.

10 Hours

UNIT – 4

Friction and Belt Drives: Definitions: Types of friction: laws of friction, Friction in pivot and collar bearings. Belt drives: Flat belt drives. Ratio of belt tensions, centrifugal tension and power transmitted. V-Belt Drive : Ratio of belt tensions, power transmitted.

10 Hours

UNIT – 5

Cams: Types of cams, Types of followers. Displacement, Velocity and Acceleration curves for SHM. Cam profiles - Disc cam with reciprocating follower having knife-edge, roller and flat-face follower.

Analysis of Cams: Analysis of Tangent cam with roller follower.

10 Hours

TEXT BOOKS:

1. "Theory of Machines", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009.

2. "Theory of Machines", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006

REFERENCE BOOKS:

1. "Theory of Machines & Mechanisms ", J.J. Uicker, , G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed. 2009.
2. Mechanism and Machine theory , Ambekar, PHI, 2007

JOINING PROCESS

Subject Code :15MA43	IA Marks :20
Hours/Week :04, No. of Credits:04	Exam Hours :03
Total Hours :52	Exam Marks :80

Course Objectives:

This course intended to equip the student with:

1. The basic concepts of welding brazing and soldering of metals and alloys.
2. Explanations of various welding processes.
3. Fundamentals of changes that take place during welding of metals.
4. Specific requirements for welding, brazing, soldering and adhesive bonding.
5. Insight into the defects that occur in welded joints, their inspection and mitigating techniques.

Course outcomes:

The student is expected to:

1. Have idea of the concepts involved in welding of metals.
2. Know the various welding processes and techniques
3. Be able to select welding processes for specific requirements for different metals
4. Be conversant with the techniques, usage, and limitations of brazing, soldering and adhesive bonding.
5. Be able to understand welding specifications and procedure qualifications and comprehend the causes for defects in welds, their remedies.

Unit 1:

Introduction and Concepts: Definition, principles, classification, applications, advantages and limitations and safety considerations in welding; Basic principles of sound welding design,

representation of weld symbols, edge preparation methods; Concepts of dissimilar metal welding and its metallurgical problems, principle of welding plastics, plastic welding processes; Welding jigs and fixtures, automation in welding, welding cost estimation and factors involved in it; Heat flow in arc welding: Heat flow equations, cooling rate equations; Peak temperate equation, weld thermal cycles and their effects; Structural changes in different materials during welding; Residual stresses and distortion; Weldability: Definition of weldability, factors affecting weldability; Weldability tests-mechanical tests; Cold cracking tests and hot cracking tests.

11 Hours

Unit 2:

Arc Welding -, principles, equipment, safety recommendations for installation and operation of arc welding equipments; Coated electrodes: electrode coatings, classification of coatings of electrodes for SMAW, SAW ; Fluxes, role of flux ingredients and shielding gases; Classification of solid and flux code wires; Flux shielded metal arc welding(FSMAW), inert gas welding(TIG & MIG); Submerged arc welding, atomic hydrogen welding, electro slag welding;

Gas Welding - principle, equipment, Safety considerations for installation and operation of gas welding equipments; Oxy-acetylene welding, oxy-hydrogen welding; Chemical reactions in gas welding, flame characteristics; Gas torch construction and working, forward and backward welding.

10 Hours

Unit 3:

Special Types of Welding, Welding of Steels and other Materials: Resistance welding - principles, variables in resistance welding, spot welding, seam welding, resistance butt welding, projection welding, resistance welding of tubes; Solid state welding – principles, cold welding, diffusion welding, ultrasonic welding; Explosive welding, friction welding, forge welding; Radiant energy welding – electron beam welding, laser beam welding explosive welding; thermit welding, under water welding, friction stir welding; Welding of steels and low alloy steels**:** problems encountered in welding of carbon steels and low alloy steels; Hydrogen induced cracking, hot cracking, lamellar tearing and reheat cracking; Welding of stainless steels**:** metallurgical difficulties in welding of austenitic, ferritic and martensitic stainless steels;

Austenitic stainless steel welding, constitution diagrams; Welding of other metals and alloys: brief description on metallurgical difficulties in welding of cast irons, aluminium alloys, copper alloys nickel alloys and titanium alloys.

10 Hours

Module 4:

Soldering – definition, principles, soldering joint design; Soldering alloys, Soldering fluxes, different soldering methods; Metallurgical aspects of soldering; Applications, Advantages and limitations of soldering;

Brazing– Definition, principles, brazing joint design; Brazing alloys, brazing fluxes; Brazing processes- torch brazing, furnace brazing, vacuum brazing; Induction brazing, dip brazing, silver brazing; Metallurgical aspects of brazing , Applications, advantages and limitations of brazing;

Adhesive bonding- steps involved in adhesive bonding; Selection and types of adhesives, applications, advantages and limitations of adhesive bonding.

11 Hours

Module 5:

Metallurgical aspects in welding- structure of welds;Formation of different zones during welding, heat affected zone(HAZ) and Parameters; Effect of carbon content on structure and properties of steel; Shrinkage in welding, residual stresses and stress relief techniques.

Welding defects- types of defects, causes and remedies.

Inspection methods- visual, magnetic particle, fluorescent particle; Ultrasonic, radiographic, eddy current, holography techniques; Basics of welding acceptance standards; Introduction to welding procedure specification; Welding procedure qualification and performance qualification.

10 Hours

TEXT BOOKS:

1. Howard B Cary, "Modern Welding Technology", Prentice Hall, 2005.

2. P.N.Rao, “Manufacturing Technology: Foundry Forming and welding”, 3rd Ed., Tata McGraw Hill, 2003.

REFERENCES:

1. ASM Metals Handbook, Vol. 6,"Welding Brazing and Soldering", ASM International, Ohio, 2003.
2. AWS Welding hand book, “Welding Science and Technology”, American Welding Society, 2001.
3. Lancaster J F, “Metallurgy of welding”, Woodhead Publishing, 1999.

FLUID MECHANICS AND MACHINES

Subject Code :15MA44	IA Marks :20
Hours/Week :03 L + 02 T, No. of Credits:04	Exam Hours :03
Total Hours :52	Exam Marks :80

Course Objectives: The students should be able to have:

1. Conceptual understanding of fluid properties and fluid statistics.
2. Understanding of fluid kinematics and fluid dynamics.
3. Basic knowledge of dimensional analysis and similitude.
4. Understanding of laminar and turbulent flows in closed conduits
5. Understanding flow measurement.
6. Evaluate the performance of centrifugal pumps and compressors

Course outcomes: At the end of this course, student will be able to:

1. Understand properties of fluids and hydrostatics.
2. Formulate and solve equations of the control volume for fluid flow systems.
3. Develop basic knowledge of dimensional analysis and similitude.
4. Calculate resistance to flow of incompressible fluids through closed conduits.
5. Solve field problems in flow measurement
6. Select pumps and compressors for different applications.

UNIT – 1

Properties of Fluids: Types of fluid, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation.

Fluid Statistics: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers.

10 Hours

UNIT – 2

Fluid Kinematics: Types of fluid flow, continuity equation in 2D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function.

Fluid Dynamics: Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

11Hours

UNIT – 3

Fluid Flow Measurements : Venturimeter, orificemeter, pitot-tube, vertical orifice, V-Notch and rectangular notches.

Dimensional Analysis : Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham π theorem, dimensionless numbers, similitude, types of similitudes. **10 Hours**

UNIT – 4

Flow through pipes : Darcy's and Chezy's equation for loss of head due to friction in pipes. **Laminar flow and viscous effects** : Reyonold's number, critical Reynold's number, laminar flow through circular pipes-Hagen Poiseille's equation, laminar flow between parallel and stationary plates.

10 Hours

UNIT – 5

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems. **11 Hours**

Text Books:

1. James E.A., John and Haberm W.A., Introduction to Fluid Mechanics, Prentice Hall of India.
2. V. L. Streeter and E. B. Wylie, Fluid Mechanics, Tata McGraw Hill Pvt Ltd. New Delhi ,2nd Edition.
3. R. K. Bansal, Fluid Mechanics, Laxmi Publication (P) Ltd. New Delhi.

Reference Books:

1. Y .A. Cengel, J. M. Cimbala, Fluid Mechanics –Fundamentals and Application, TMI.
2. S. K. Som and G. Biswas, Introduction to Fluid Mechanics and Fluid Machines, TMH.
3. R.K. Rajput, Fluid Mechanics and Hydraulic Machines, S. Chand, and Company Ltd.

MACHINE TOOLS AND OPERATIONS

Subject Code	:15MA45	IA Marks	:20
Hours/Week	:04 L, No. of Credits:04	Exam Hours	:03
Total Hours	:52	Exam Marks	:80

COMMON TO 15ME35B / 45B

MECHANICAL MEASUREMENTS AND METROLOGY

Subject Code	: 15MA46	IA Marks	:20
Hours/Week	:04 L, No. of Credits:04	Exam Hours	:03
Total Hours	:52	Exam Marks	:80

Common to 15ME36B / 46B

Metrology & Machine Tool Laboratory

Subject Code : 15MAL47	IA Marks :20
Hours/Week :01L+02P, No. of Credits:04	Exam Hours :03
Total Hours :42	Exam Marks :80

Course Objectives:

This course intended to equip the student with:

1. Knowledge of calibration and measurements
2. Understanding of procedures of calibration and principles of measurement
3. Practical exposure of calibration of machine tools, measuring instruments and measurement of profiles mechanical components.

Course Outcomes

At the end of this course, student will:

1. Have the knowledge of Calibration and measurements.
2. Implement the calibration of the machine tools and measuring instruments.
3. Carry out the calibrations of machine tools and measurement of profiles of mechanical components.

PART - A

1. Calibration of Micrometer using slip gauges
2. Calibration of LVDT
3. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer/Optical Projector
4. Measurement of Screw thread Parameters using Two wire or Three-wire method.
5. Measurements of Surface roughness, using Tally Surf/Mechanical Comparator

PART - B

1. Acceptance tests on a lathe/Drilling/Milling Machine
2. Cutting force measurement of turning /drilling/milling using Dynamo meters
3. Measurement of cutting tool temperature using thermo-couples
4. Determination of chip-reduction co-efficient during metal cutting on a lathe

WELDING PRACTICE

Subject Code	: 15MAL48	IA Marks	:20
Hours/Week	:01L+02P, No. of Credits:04	Exam Hours	:03
Total Hours	:42	Exam Marks	:80

Course Objectives:

This course intended to equip the student with:

4. Procedure of preparing jobs for welding.
5. Knowledge of different welding techniques and equipment rating.
6. Understanding of safety precautions to be followed while welding.
7. Practical exposure of making joints using arc/ gas / TIG / MIG welding type

8. Post weld testing, inspection and analysis

Course Outcomes

At the end of this course, student will be able to:

4. Prepare jobs for welding
5. Choose proper parameters for welding
6. Make joints adopting safety measures
7. Test, inspect and analyze welded joints

PART - A

1. Making of welded lap, butt, T & L joints using arc welding process
2. Making of two joints using gas welding.
3. Making of at least one joint using TIG welding technique
4. Making of at least one joint using MIG welding technique

PART - B

5. Testing of welded joints as per BIS
6. Microstructure study of welded joints
7. Inspection of welded joints by dye penetration and ultrasonic method.