

STRENGTH OF MATERIALS - I

CODE ME 31

AR 31/CE 31/MA 31/MP 31

L T P

2 2/2 2

RATIONALE

In Engineering every structure or machine element is designed for a particular application. Then it is tested. A Diploma holder should be capable of designing the various elements for particular requirements. For this he must be able to calculate the stresses in an elements and their nature.

CONTENTS**1. Simple Stress and Strain :**

- 1.1 Various mechanical properties
 - 1.1.1 Elasticity
 - 1.1.2 Plasticity
 - 1.1.3 Ductility
 - 1.1.4 Brittleness
 - 1.1.5 Toughness
 - 1.1.6 Hardness
- 1.2 Concept of stress and strain
 - 1.2.1 Type of force - Direct, shear
 - 1.2.2 Stress - Tensile, compressive, shear
- 1.3 Hook's law
 - 1.3.1 Statement of Hook's law
 - 1.3.2 Young's modulus of elasticity
 - 1.3.3 Tensile test diagram
 - 1.3.3.1 Gauge length
 - 1.3.3.2 Limit of proportionality
 - 1.3.3.3 Elastic limit
 - 1.3.3.4 Yield point, Yield strength
 - 1.3.3.5 Ultimate stress
 - 1.3.3.6 Rupture strength
 - 1.3.3.7 Nominal stress
 - 1.3.3.8 Proof stress
- 1.4 Working stress and factor of safety
- 1.5 Stress and strain calculations

- 1.5.1 Principle of superposition
- 1.5.2 Bar of homogeneous section
 - 1.5.2.1 Bar of uniform cross-section
 - 1.5.2.2 Bar of stepped cross-section
- 1.5.3 Bar of composite section
- 1.6 Temperature stresses
 - 1.6.1 Homogeneous section
 - 1.6.2 Composite section
- 1.7 Shear stresses
 - 1.7.1 Modulus of rigidity
 - 1.7.2 Complementary shear stress
 - 1.7.3 Concept of single shear and double shear
 - 1.7.4 Shear strain
- 1.8 Poisson's ratio and volumetric strain
 - 1.8.1 Lateral strain
 - 1.8.2 Longitudinal strain
 - 1.8.3 Volumetric strain
 - 1.8.4 Bulk modulus
- 1.9 Relationship between elastic constants (Derivation)
 - 1.9.1 $E=3K(1-2/m)$
 - 1.9.2 $E=2N(1+1/m)$
 - 1.9.3 $E=9KN/(3K+N)$

2. Compound Stress :

- 2.1 Introduction
- 2.2 Stress components on an inclined plane
 - 2.2.1 Induced by direct stresses
 - 2.2.2 Induced by simple shear
 - 2.2.3 Induced by direct and simple shear stresses
- 2.3 Mohr's circle :
 - 2.3.1 For like direct stresses
 - 2.3.2 For unlike direct stresses

- 2.3.3 For two perpendicular direct stresses with state of simple shear
- 2.4 Principal stresses and planes
 - 2.4.1 Major principal stress
 - 2.4.2 Minor principal stress
 - 2.4.3 Mohr's circle method for principal stresses
- 3. Strain Energy :**
 - 3.1 Introduction
 - 3.2 Strain energy from stress - strain diagram
 - 3.3 Proof resilience
 - 3.4 Types of loading - gradual, sudden, impact
 - 3.4.1 Stress in gradual loading
 - 3.4.2 Stress in sudden loading
 - 3.4.3 Stress in impact loading
- 4. Bending Moments and Shear Force :**
 - 4.1 Basic concept
 - 4.1.1 Types of support
 - 4.1.1.1 Movable hinge support (roller)
 - 4.1.1.2 Immovable hinge support
 - 4.1.1.3 Fixed support
 - 4.1.2 Types of beam
 - 4.1.2.1 Cantilever beam
 - 4.1.2.2 Simply supported beam
 - 4.1.2.3 Fixed beam
 - 4.1.2.4 Continuous beam
 - 4.1.2.5 Overhanging beam
 - 4.1.3 Types of load
 - 4.1.3.1 Point load
 - 4.1.3.2 Distributed load - uniformly and non uniformly
 - 4.2 Shear force and bending moment
 - 4.2.1 Concept and calculation of shear force and bending moment
 - 4.2.2 Sign convention for shear force and bending moment

4.3 Bending moment and shear force diagrams (for point loads, U.D.L. and their combinations)

4.3.1 Cantilever beam

4.3.2 Simply supported beam

4.3.3 Simply supported beam with over hang

5. Moment of Inertia :

5.1 Concept of moment of Inertia

5.2 Radius of gyration

5.2.1 Parallel axis theorem

5.2.2 Perpendicular axis theorem

5.3 Moment of Inertia of various section

5.3.1 Rectangle

5.3.2 Triangle

5.3.3 Circle

5.4 Moment of inertia of unsymmetrical section like : T-section, channel section, L-section etc.

6. Bending Stresses in Beams :

6.1 Concept of bending stress

6.2 Theory of simple bending

6.2.1 Assumptions in theory of simple bending

6.2.2 Use of equation $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$ (without proof)

6.3 Design criterion and section modulus

6.3.1 Section modulus

6.3.2 Calculation of max bending stress in beams of rectangular, circular, I and T section

7. Shear Stress in Beams :

7.1 Concept

7.2 Use of equation $q = \frac{F}{Ib}(\bar{A}y)$ (without proof)

7.3 Shear stress distribution diagram of various sections

- 7.3.1 Rectangle
- 7.3.2 I section
- 7.3.3 T section
- 7.3.4 Channel section
- 7.3.5 H section
- 7.3.6 + section
- 7.3.7 Circular section

PRACTICALS

1. Study of extensometers
2. Study and operation of UTM
3. Tensile test on mild steel specimen and plotting stress strain curve.
4. Bending test on timber beams.
5. Compression test on common structural materials viz. timber, cast iron etc.
6. Determination of toughness of cast iron and mild steel specimen by Charpy and Izod test.
7. Hardness test by Brinell and Rockwell test.

REFERENCE BOOKS :

- | | |
|-------------------------------------------------------------|-----------------|
| 1. Strength of Materials &
Theory of Structures (vol. I) | B.C.Punmia |
| 2. Strength of Materials | Ramamurtham |
| 3. Strength of Materials | Junarkar |
| 4. Strength of Materials | R.S. Khurmi |
| 5. Strength of Materials (Hindi) | Gurcharan singh |

FLUID MECHANICS - I

CODE ME 32
CE 32/MA 32

L T P
2 2/2 2

RATIONALE

Technicians have to deal with pressure measurement, transportation of fluids and the machines converting hydraulic power into mechanical power and vice versa, in the field/industries for that one has to have a basic knowledge of fluid mechanics. Topics such as pressure measurement, laws governing the flow of liquids, measurement of discharge, production of power are included in this subject.

Although the major emphasis in this subject is on the study of liquids like water an incompressible fluid yet all the principles are applicable to all the fluids such as air, gas, steam etc.

CONTENTS

1. Introduction :

- 1.1 Introduction concepts
 - 1.1.1 Fluids and solids
 - 1.1.2 Liquid, gas and vapour
- 1.2 Fluid mechanics
 - 1.2.1 Kinematics
 - 1.2.2 Dynamics
- 1.3 Fluid properties
 - 1.3.1 Density
 - 1.3.2 Specific volume
 - 1.3.3 Specific gravity
 - 1.3.4 Viscosity
 - 1.3.4.1 Newton's law of Viscosity
 - 1.3.4.2 Dynamic and Kinematic Viscosity
 - 1.3.5 Compressibility
 - 1.3.6 Surface tension - soap bubble, drop
 - 1.3.7 Capillarity
 - 1.3.8 Vapour pressure and its importance

2. Fluid Pressure and its Measurement :

- 2.1 Definition and its units
- 2.2 Pascal's law
 - 2.2.1 Intensity of pressure at a point in fluid at rest
 - 2.2.2 Pressure head
- 2.3 Pressure
 - 2.3.1 Atmospheric pressure
 - 2.3.2 Gauge pressure
 - 2.3.3 Vacuum pressure
 - 2.3.4 Absolute pressure
 - 2.3.5 Differentials pressure
- 2.4 Law of hydrostatic pressure
- 2.5 Brahma's press
- 2.6 Pressure measurement
 - 2.6.1 Manometers
 - 2.6.1.1 Piezometer - its limitation
 - 2.6.1.2 U-tube - simple, differential, inverted
 - 2.6.1.3 Micro-manometers
 - 2.6.1.4 Inclined tube micro-manometers
 - 2.6.2 Mechanical gauge
 - 2.6.2.1 Bourdon gauge
 - 2.6.2.2 Bellow gauge
 - 2.6.2.3 Diaphragm gauge
 - 2.6.2.4 Dead weight gauge
- 3. Hydrostatics :**
 - 3.1 Total pressure
 - 3.2 Centre of pressure
 - 3.3 Total pressure and center of pressure in following cases
 - 3.3.1 Plane surface immersed horizontally
 - 3.3.2 Plane surface immersed vertically
 - 3.3.3 Plane surface immersed at an angle
 - 3.3.4 Curved surface (no proof)
 - 3.4 Working of lock gates, sluice gate
 - 3.5 Pressure on masonry dams of rectangular and trapezoidal sections and their condition of stability
- 4. Hydrokinematics :**

- 4.1 Description of fluid flow
 - 4.1.1 Euler approach
 - 4.1.2 Lagrangian approach
- 4.2 Definition of path line, stream line
- 4.3 Types of flow
 - 4.3.1 Steady - Non steady
 - 4.3.2 Uniform - Non uniform
 - 4.3.3 Laminar - Turbulent
 - 4.3.4 One, Two, Three dimensional flow
- 4.4 Continuity equation (no proof) :
 - 4.4.1 Assumption
 - 4.4.2 Rate of discharge
 - 4.4.3 For one dimensional flow

5. **Hydrodynamics and Measurement of Flow :**

- 5.1 Energy of fluid - pressure, kinetic and potential
- 5.2 Bernoulli's theorem (no proof)
 - 5.2.1 Assumptions and its limitation
 - 5.2.2 Conversion of pressure into pressure head, velocity into kinetic head
- 5.3 Applications of Bernoulli's theorem
 - 5.3.1 Pitot-tube
 - 5.3.2 Venturimeter
 - 5.3.3 Orificemeter

6. **Orifices and Notches :**

- 6.1 Definition and classification
- 6.2 Discharge through small orifices
 - 6.2.1 Coefficient of contraction
 - 6.2.2 Coefficient of velocity
 - 6.2.3 Coefficient of discharge
 - 6.2.4 Coefficient of resistance
- 6.3 Time of emptying a vessel of uniform cross section through an orifice at bottom.
- 6.4 Notches - Classification

- 6.4.1 Crest, Nappe
 - 6.4.2 Difference between notch and weir

 - 6.5 Flow over -
 - 6.5.1 Triangular notch
 - 6.5.2 Rectangular notch
- [Simple numerical problems without velocity of approach]

PRACTICALS.

1. Study of different types of manometers and pressure gauges
2. Verification of Bernoulli's theorem
3. Determination of C_d for Venturimeter
4. Determination of C_d for Orificemeter
5. Determination of C_c, C_v and C_d of small orifice
6. Visit of a near by dam

REFERENCE BOOKS :

- | | | |
|----|----------------------------|-----------------|
| 1. | Fluid Mechanics & Machines | Dr. Jagdish Lal |
| 2. | Fluid Mechanics & Machines | Dr. R.K.Bansal |
| 3. | Fluid Mechanics & Machines | R.S.Khurmi. |
| 4. | Hydraulics & Pneumatics | H.L. Stewart. |

MANUFACTURING PROCESS - I

CODE ME 33

MA 33/ MP 33

L T P

4 - 2

RATIONALE

This subject provides an opportunity to the student to learn about various welding processes and foundry work. Welding is very useful for fabrication work and Foundry for production of castings used for manufacturing of machines. This also gives knowledge of metal cutting mechanism to the student. Theory is to be supported by visits to industries and case studies. This will help in developing proper attitude and skill to the technicians. Hence the technicians will be in a position to help and solve the problems of industry.

CONTENTS

1. Welding Process :

- 1.1 Classification of welding process, Industrial applications of welding.

2. Gas Welding :

- 2.1 Principle of oxy-acetylene gas welding, Construction of oxy-acetylene cutting torch and gas welding torch
 2.2 Blowpipes, single stage and double stage regulators.
 2.3 Gas cutting (oxy-acetylene), lance cutting, flames gauging, grooving

3. Electric Welding Process :

- 3.1 Difference between A.C and D.C arc welding, Equipments and accessories of A.C and D.C welding plants
 3.2 Effect of polarity, length of arc, penetration, crater, arc blow
 3.3 Electrodes (Metal and Carbon), B.I.S specification for welding Symbols and electrodes, Flux and their functions
 3.4 Resistance welding
 3.4.1 Spot welding, butt welding, flash welding
 3.4.2 Seam welding, percussion welding and projection welding
 3.5 Atomic hydrogen welding
 3.6 Shielded metal arc welding, Submerged arc welding
 3.7 Pressure welding
 3.8 Welding distortion, welding defects, method of controlling welding defects and inspection of welded joints

4. Modern Welding Methods :

- 4.1 Tungsten inert gas welding (TIG)
 - 4.1.1 Principle of operation, advantage, disadvantages, application
- 4.2 Metal inert gas welding (MIG)
 - 4.2.1 Principle of operation, advantage, disadvantages, application
- 4.3 Thermit welding
- 4.4 Electroslag welding, Electron beam welding
- 4.5 Ultrasonic welding, Laser beam welding
- 4.6 Robotic welding

5. Pattern Making :

- 5.1 Introduction to materials - timber, metal, plastics and plaster of Paris etc.
- 5.2 Allowances- shrinkage, draft, machining, distortion and shake

6. Types of Pattern :

- 6.1 Solid, Split loose piece, match plate
- 6.2 Sweep, Gated, Skeleton, segmental, follow board, colour code for patterns as per B.I.S.

7. Moulding Sand Ingredients :

- 7.1 Moulding sands-green, dry, loam, facing, baking, parting and core sands.
- 7.2 Silica grain, binders, additive, moisture
- 7.3 Properties of molding - sand, permeability, refractoriness, adhesiveness, cohesiveness, strength, flowability, collapsibility
- 7.4 Tempering, sand conditioning and sand muller.

8. Core and Core Making :

- 8.1 Core, core print and core boxes
- 8.2 Types of cores, functions, advantage of core, shrinkage of cores
- 8.3 Core sand and binders, core loams, oil and CO₂ cores, synthetic resin
- 8.4 Core Making procedure, core oven and core baking.

9. Testing of Moulding Sands :

- 9.1 Need for testing chemical analysis, moisture content test, clay content test, Grain fineness test
- 9.2 Permeability test and strength test.

10. Mould Making :

- 10.1 Moulding boxes, hand tools used for mould making
- 10.2 Steps involved in making a mould, gating system: definition and brief idea of basin, sprue, runner and gates
- 10.3 Moulding machines - Squeeze machine, jolt squeeze machine and sand slinger.
- 10.4 Moulding processes - Green sand, dry sand, loam, Co₂ moulding, skin dried, plaster, metal moulding

11. Special Casting Techniques :

- 11.1 Die casting - Hot chamber, cold chamber process
- 11.2 Investment or lost wax process
- 11.3 Centrifugal casting - True, Semi centrifugal, centrifugal
- 11.4 Shell moulding
Advantages, Disadvantages and application of above processes

12. Melting Furnaces :

- 12.1 Cupola furnace - Construction, operation, preparation, charging
- 12.2 Crucible furnace of tilting types - construction, operation

13. Castings :

- 13.1 Different types of defects
- 13.2 Testing of defects - Radiography, magnetic particle inspection, Ultrasonic inspection

PRACTICALS

1. Making following types of joints by gas welding :

- 1.1 Preliminary joining practice on gas welding
- 1.2 Vertical welding

2. Exercises of gas welding on the following

- 2.1 Aluminium welding
- 2.2 Brass welding
- 2.3 Copper welding
- 2.4 C.I. welding

3. Gas cutting of the following types

- 3.1 Preliminary gas cutting practice
- 3.2 Stock cutting by oxy acetylene
- 3.3 C.I. cutting

4. Making following types of joints by arc welding

- 4.1 Preliminary joining practice by arc welding
- 4.2 Butt and lap joint (in vertical position travel up and down)
- 4.3 Welding of outside corner joint

5. Exercise on spot welding**6. Exercise on brazing****7. Exercise on TIG/MIG/CO₂ welding****8. Pattern making :**

- 8.1 Preparation of solid pattern (single piece)
- 8.2 Preparation of split pattern
- 8.3 Preparation of self cored pattern

9. Preparation of the following types of moulds .

- 9.1 Floor moulding
- 9.2 Turn over moulding.

10. Testing of moulding sand- moisture content**11. Moulding and casting of**

- 11.1 A solid pattern
- 11.2 A split pattern

12. Testing and inspection of casting defects visually

Foundry exercise can be shown in a nearby industry/ foundry.

REFERENCE BOOKS :

- | | |
|--------------------------------------|---------------------|
| 1. A Text Book of Welding Technology | O.P. Khanna |
| 2. Welding Technology | Tahil Maghnani |
| 3. A Text Book on Foundry Technology | M.Lal & O.P.Khanna. |
| 4. Foundry Engineering | Tahil Meghnani |
| 5. Manufacturing Process - I | R.K. Yadav |

THERMAL ENGINEERING - I

CODE ME 34
MA 34

L T P
3 -- 2

RATIONALE

For technical education in mechanical engineering field the subject of thermal engineering is very important for understanding the basic principles and concept of thermodynamics and its application.

CONTENTS

1. Basic Concept and Gas Laws :

- 1.1 Thermodynamics, property-Intensive and Extensive, system - open, closed and isolated
- 1.2 Energy - Internal energy, potential energy, kinetic energy, heat, work, specific heat, enthalpy
- 1.3 Boyle's law, Charle's law, Joule's law
- 1.4 Characteristics gas equation, gas constant, mol, universal gas constant and molar specific heats
- 1.5 Simple numerical problems

2. Laws of Thermodynamics :

- 2.1 Zeroth law of thermodynamics
- 2.2 First law of thermodynamics.
- 2.3 Second law of thermodynamics Concept of entropy
- 2.4 Constant volume, constant pressure, isothermal, adiabatic polytropic processes, throttling and free expansion, work done during these processes.
- 2.5 Simple numerical problems

3. Availability :

- 3.1 Available and unavailable energy
- 3.2 Effectiveness
- 3.3 Irreversibility in flow and non-flow process.

4. Formation of Steam and its Properties :

- 4.1 Generation of steam at constant pressure, various stage of steam-wet steam, dry steam saturated steam, dryness fraction, super heated steam, degree of super heat.
- 4.2 Critical point, triple point, thermodynamic properties of steam - specific volume, specific enthalpy, specific internal energy, specific entropy.

- 4.3 Steam property diagram: temperature - entropy diagram, enthalpy- entropy diagram, pressure - enthalpy diagram
- 4.4 Heating and expansion of steam during thermodynamic processes, Change of internal energy and entropy of steam during processes
- 4.5 Simple numerical problems Use of steam tables and Mollier charts.

5. Steam Generators :

- 5.1 Definition of boiler according to I.B.R., classification of boilers, description and working of Lancashire, Cochran and Babcock and Wilcox boilers, Comparison of water tube and fire tube boilers.
- 5.2 Brief description and working of boiler mountings and accessories used in common boilers.
- 5.3 Special characteristics of high-pressure boilers, Structural details and working of Lamont, Benson and Schmidt Hartmann boilers
- 5.4 Introduction to Indian Boiler Act.

6. Boiler Performance :

- 6.1 Actual evaporation, Equivalent evaporation, Factor of evaporation, Boiler efficiency
- 6.2 Heat losses in boiler plants, Boiler power, Energy balance sheet of boiler.
- 6.3 Simple numerical problems

7. Vapour Power Cycle :

- 7.1 Rankine cycle, modified rankine cycle, representation on p-v, t-s and h-s charts and efficiency
- 7.2 Simple numerical problems

PRACTICALS

1. Study by models/charts/actual units of the following:

- 1.1 Common type of fire tube and water tube boilers.
- 1.2 Boiler mountings
- 1.3 Boiler accessories
- 1.4 High pressure boilers

2. Determination of dryness fraction of steam by separating and throttling calorimeter

REFERENCE BOOKS :

- | | |
|------------------------------------|------------------------|
| 1. Thermal Engineering (Hindi) | Verma & Gulecha |
| 2. Thermal Engineering Vol.1 | Mathur & Mehta . |
| 3. Thermal Engineering | R.K.Purohit. |
| 4. Thermal Engineering | R.S. Khurmi |
| 5. Elements of Heat Engines -Vol.1 | Patel & Karam Chandani |

MATERIALS AND MATERIAL SCIENCECODE ME 35
MA 35L T P
2 -- 2**RATIONALE**

Lot of development has taken place in the field of materials. New materials are being developed. It has become possible to change the properties of materials to suit the requirements. Diploma holders in mechanical engineering are required to make use of different materials for various applications. For this purpose, it is necessary to teach them basics of metal structure, properties, usage and testing of various ferrous and nonferrous materials and various heat treatment processes. This subject aim at developing knowledge about characteristics, testing and usage of various types of materials used in mechanical engineering industry.

CONTENTS**1. Classification and Properties of Materials :**

- 1.1 Introduction to engineering materials
- 1.2 Classification of materials
- 1.3 Thermal, chemical, electrical, mechanical properties of various materials
- 1.4 Selection criteria for use in industry

2. Structure of Metals and Their Deformation :

- 2.1 Metal structure
- 2.2 Arrangement of atoms in metals
- 2.3 Crystalline structure of metals
- 2.4 Crystal imperfections
- 2.5 Deformation of metal
- 2.6 Impact of cold and hot working on metal structure.

3. Ferrous Materials :

- 3.1 Classification of iron and steel
- 3.2 Sources of Iron ore and its availability
- 3.3 Manufacture of pig iron, wrought iron, cast iron and steel
- 3.4 Types of cast iron: white, malleable grey, mottled, nodular and alloy and their usage.
- 3.5 Classification of steels
- 3.6 Different manufacturing method of steel open hearth, bessemer, electric arc.
- 3.7 Specification as per BIS and equivalent standards
- 3.8 Effect of various alloying elements on steel
- 3.9 Use of alloy steel (high-speed steel, stainless steel, spring steel, silicon steel)

4. Non Ferrous Materials :

- 4.1 Important ores and properties of aluminium, copper, zinc, tin, lead
- 4.2 Properties and uses of nonferrous alloys

5. Engineering Plastics and Fibers :

- 5.1 Introduction of plastics
- 5.2 Classification - Thermoplastic and thermosetting
- 5.3 Various trade names of engineering plastics
- 5.4 Fibers and their classification : Inorganic and organic fibers
- 5.5 Uses of fiber

6. Insulating Materials :

- 6.1 Various heat insulating material and their usage like asbestos, glass, wool thermocole, cork, puf, china clay.
- 6.2 Various electrical insulating materials and their use.

7. Testing of Metals and Alloys :

- 7.1 Identification tests : appearance, sound, spark, weight, magnetic, band microstructure, filing

8. Fundamental of Heat Treatment :

- 8.1 Principles of heat treatment
- 8.2 Theory of solid solution
- 8.3 Iron-carbon diagram
- 8.4 TTT curve in steels and its importance
- 8.5 Basic idea about martensitic transformation
- 8.6 Various heat treatment processes - hardening, tempering, annealing, normalising, case hardening and surface hardening.
- 8.7 Types of heat treatment surfaces.

PRACTICALS**1. Classification of about 25 specimens of materials / parts into**

- 1.1 Metals and non metals
- 1.2 Metals and alloys
- 1.3 Metals and non ferrous metals
- 1.4 Metals and non ferrous alloys

2. Given and set of specimen of metals and alloys (copper, brass, aluminium, cast iron HSS, Gun metal) : identify and indicate the various properties posseses by them

3.
 - 3.1 Study of heat treatment furnace
 - 3.2 Study of thermocouple / pyrometer
4. Study of a metallurgical microscope and a diamond-polishing machine.
5. To prepare specimens of following materials for microscopic examination and to examine the microstructure of the specimens of the following materials :
 - 5.1 Brass
 - 5.2 Copper
 - 5.3 Grey CI
 - 5.4 Malleable CI
 - 5.5 Low carbon steel
 - 5.6 High carbon steel
 - 5.7 HSS
6. To temper a given specimen and find out difference in hardness (with the help of hardness tester) as a result of tempering.

REFERENCE BOOKS :

- | | |
|----------------------------------------|----------------|
| 1. Engineering Material | B.K. Agarwal |
| 2. Elements of Metallurgy | H.S. Bawa |
| 3. Materials and Metallurgy Lab Manual | Adithan & Bahl |
| 4. Material Science | R.K. Rajput |

ELECTRICAL ENGINEERING

CODE ME 36
MR 36

L T P
3 -- 2

RATIONALE

This subject is designed to give basic knowledge of electrical m/c such as transformer, A.C./D.C. machine.

CONTENTS**1. D.C. Machines :**

- 1.1 Construction
- 1.2 Operation of D.C. generator
- 1.3 Operation of D.C. motor
- 1.4 Types of D.C. generator and motor
- 1.5 Starters
- 1.6 Speed control methods
- 1.7 Characteristics of D.C. motors

2. Transformer :

- 2.1 Construction of single phase transformer
- 2.2 Types of transformer
- 2.3 Principle of operation
- 2.4 E.M.F equation
- 2.5 Testing of T/F
 - 2.5.1 Polarity test
 - 2.5.2 Open circuit test
 - 2.5.3 Short circuit test
- 2.6 Efficiency and losses
- 2.7 Voltage regulation
- 2.8 Single phase auto transformer
- 2.9 Types of 3 phase transformers
- 2.10 Cooling methods

3. Induction Motor :

- 3.1 Construction and working principle of single-phase induction motor
- 3.2 Types of single phase induction motors (description only)
- 3.3 Production of rotating magnetic field by three phase currents.
- 3.4 Construction and working principle of three-phase induction motor
- 3.5 Torque equation
- 3.6 Torque slip characteristics
- 3.7 Starting and speed control of 3-phase induction motor
- 3.8 Various types of starters
- 3.9 Methods of increasing starting torque
- 3.10 Application

4. Industrial Drives :

- 4.1 Elementary idea for industrial drives
- 4.2 Application of industrial drives in following fields -
 - 4.2.1 Rolling mill
 - 4.2.2 Textile mills
 - 4.2.3 Paper mill
 - 4.2.4 Crane
 - 4.2.5 Mines
 - 4.2.6 Lathe machine
 - 4.2.7 Pumps
 - 4.2.8 Food processor, refrigerators punches

5. Electric Heating :

- 5.1 Advantages of electric heating over other types of heating
- 5.2 Principle of operation, construction and uses of electrical heating in -
 - 5.2.1 Resistance heating
 - 5.2.2 Induction heating
 - 5.2.3 Arc heating
- 5.3 Brief idea of high frequency heating, dielectric heating and its application.

6. Illumination :

- 6.1 Nature of light
- 6.2 Standard terms and definitions
- 6.3 Laws of illumination
- 6.4 Types of lamps
 - 6.4.1 Tungston
 - 6.4.2 Halogen
 - 6.4.3 Sodium
 - 6.4.4 Neon
 - 6.4.5 Mercury vapour lamp
 - 6.4.6 Fluorescent tubes.

7. Instrumentation and Measurement :

- 7.1 Principle, construction and working of the following measuring instruments -
 - 7.1.1 Ammeter and voltmeter (moving coil and moving iron type)
 - 7.1.2 Dynamometer types wattmeter
 - 7.1.3 Single phase AC energy meter
 - 7.1.4 Multimeter and megger
- 7.2 Transducers
- 7.3 Measurements of mechanical quantities like pressure, strain, temperature

PRACTICALS

1. Study of D.C. machines.
2. Study of D.C. starter
3. Connecting starting and reversing the direction of D.C. motor
4. Determination of turn ratio of transformer
5. Open circuit and short circuit test on a single phase transformer

6. Determination of efficiency and regulation of a 1-phase transformer by direct loading.
7. Connecting, starting and reversing the direction of 1-phase induction motor
8. Starting of 3 phase Induction motor by D.O.L. starter / star- delta starter. motor.
9. Study of various types of transducers.
10. Study and calibration of different ammeter and voltmeter
11. Use of megger and multimeter.

REFERENCE BOOKS :

- | | |
|---------------------------------------------------------------|--------------|
| 1. Electrical Engineering (Hindi & English) | K.D. Sharma |
| 2. Electrical Technology | B.L. Theraja |
| 3. Utilization of Electrical Power | H. Pratap |
| 4. Electrical and Electronic Instrumentation
& Measurement | H. Cotton |

MACHINE DRAWING

CODE ME 37
MA 37

L T P
-- -- 6

RATIONALE

In order to produce a good product, a neat drawing is a must. Therefore technicians must be well acquainted with the knowledge of machine drawing. Machine drawing is the universal language of engineers and students must be made familiar with all the relevant aspect topics of machine drawing.

Subject contains various drawings of machine and components to clarify the manufacturing and construction details for the students.

CONTENTS

1. Coupling :

- 1.1 Split muff coupling
- 1.2 Universal coupling
- 1.3 Flexible bushed pin type

2. Bearings :

- 2.1 Types of bearings
- 2.2 Plumber block
- 2.3 Foot step bearing

3. Machine Components :

- 3.1 Machine vice
- 3.2 Tail stock of lathe
- 3.3 Shaper tool head

4. Valves :

- 4.1 Classification of valves
- 4.2 Valve seats
- 4.3 Steam stop valve
- 4.4 Feed check valve

5. I. C. Engine Components :

- 5.1 Piston and connecting rod assembly

6. Jigs and Fixtures :

- 6.1 Definitions
- 6.2 Types of jig, bushes
- 6.3 Drilling jigs
- 6.4 Types of fixtures

PRACTICALS

Preparation of assembly drawing sheets from detailed drawings :

- 1. Couplings
- 2. Plummer block and foot step bearing
- 3. Machine vice
- 4. Tail stock
- 5. Shaper tool head
- 6. Steam stop valve
- 7. Feed check valve
- 8. I.C. Engine connecting rod and piston
- 9. Drilling jig

Exercises for sketch book :

- 1. Jigs, Bushes and fixtures
- 2. Pulleys : Straight arm pulley, loose and fast pulley
- 3. Pipe fittings and pipe joints - Pipe fittings and their symbols, flanged pipe joint and spigot and socket joint

REFERENCE BOOKS :

- | | |
|--------------------|--------------------------|
| 1. Machine Drawing | Laxmi Narayanan & Mathur |
| 2. Machine Drawing | P.S Gill |
| 3. Machine Drawing | R.B.Gupta |
| 4. Machine Drawing | Sidheswar |

STRENGTH OF MATERIALS - II

CODE ME 41

CE 41/MA 41

L T P

2 2/2 2

RATIONALE

In Engineering every structure or machine element is designed for a particular application. Then it is tested. A Diploma holder should be capable of designing the various elements for particular requirements. For this he must be able to calculate the stresses in an elements and their nature.

CONTENTS**1. Deflection :**

- 1.1 Concept of deflection of a beam
- 1.2 Use of standard formula for calculating deflection (for point loads, U.D.L. and their combination)
 - 1.2.1 Cantilever beam
 - 1.2.2 Simply supported beam

2. Columns and Struts :

- 2.1 Concept of column and struts
- 2.2 Modes of failure
- 2.3 Types of column; long and short
- 2.4 Buckling loads
- 2.5 Slenderness ratio
- 2.6 Euler's formula (without proof)
 - 2.6.1 Both ends hinged
 - 2.6.2 One end fixed and other end free
 - 2.6.3 Both ends fixed
 - 2.6.4 One end fixed and other end hinged
 - 2.6.5 Limitations of Euler's Formula
 - 2.6.6 Equivalent length
- 2.7 Rankine's formula

3. Torsion of Shaft :

- 3.1 Concept of torsion
 - 3.1.1 Angle of twist
 - 3.1.2 Polar moment of Inertia

- 3.1.3 Assumptions in the theory of pure torsion
- 3.2 Derivation and use of
$$\frac{q}{r} = \frac{T}{J} = \frac{N\theta}{l}$$
- 3.3 Relation between power and torque
- 3.4 Combined stress due to bending and torsion in solid and hollow shaft
- 4. Springs :**
 - 4.1 Introduction and classification of springs
 - 4.2 Flat carriage springs
 - 4.2.1 Application of flat carriage springs
 - 4.2.2 Determination of number of leaves and their sections, deflection and radius of curvature
 - 4.2.3 Quarter elliptical spring
 - 4.3 Closely coiled helical springs :
 - 4.3.1 Application of closely coiled helical springs
 - 4.3.2 Determination of deflection, angle of twist, number of coils and stiffness under axial loading in closely coiled helical springs.
- 5. Thin Cylindrical Shells :**
 - 5.1 Use of cylinders
 - 5.2 Stresses due to internal pressure
 - 5.2.1 Circumferential stress or hoop stress
 - 5.2.2 Longitudinal stress
 - 5.3 Design of thin cylinders - calculation of the various dimensions of a thin cylinder
- 6. Combined Direct and Bending Stress :**
 - 6.1 Effect of eccentricity
 - 6.2 Stress due to eccentric load
 - 6.3 Middle third rule
- 7. Frames :**
 - 7.1 Different types of frames
 - 7.2 Calculation of forces in the members of determinate frames

- 7.2.1 Method of Joints
- 7.2.2 Method of section
- 7.2.3 Graphical method

PRACTICALS

1. Determination of deflection for various types of loading
2. Torsion test on brass and mild steel
3. Compression test on columns
4. Determination of stiffness of close coiled spring
5. Deflection test on leaf spring.

REFERENCE BOOKS :

- | | |
|-------------------------------------------------------------|-----------------|
| 1. Strength of Materials &
Theory of Structures (Vol. I) | B.C.Punmia |
| 2. Strength of Materials | Ramamurtham |
| 3. Strength of Materials | Junarkar |
| 4. Strength of Materials | R.S. Khurmi |
| 5. Strength of Materials (Hindi) | Gurcharan Singh |

FLUID MACHINES

CODE ME 42
MA 42

L T P
2 2/2 2

RATIONALE

A Diploma holder has to supervise the various machines working on the principles of hydraulics. Major among those machines are hydraulic turbines, pumps, hydraulic crane, presses etc. The aim of this subject is to impart the knowledge of working principles, construction and working of various machines.

CONTENTS

1. Flow Through Pipes :

1.1 Types of flow in pipes (Reynold's experiment)

1.1.1 Laminar flow

1.1.2 Turbulent flow

1.1.3 Transient flow

1.2 Law of fluid friction

1.2.1 Laminar flow

1.2.2 Turbulent flow

1.3 Loss of head due to friction (No. proof)

1.3.1 Darcy's Weisbach equations

1.3.2 Chezy's formula

1.3.3 Manning formula

1.4 Other energy losses in pipe (only expressions)

1.5 Total energy line and hydraulic gradient line

1.6 Pipe arrangement

1.6.1 Pipes in series

1.6.2 Pipes in parallel

1.7 Transmission of power through pipes

1.8 Siphon

1.9 Water hammer

2. Impact of Free Jet :

2.1 Impulse momentum equation (no proof)

- 2.2 Force exerted by a fluid jet on stationary flat plate
 - 2.2.1 Plate normal to the jet
 - 2.2.2 Plate inclined to the jet
- 2.3 Force exerted by fluid jet on moving flat plate
 - 2.3.1 Plate normal to the jet
 - 2.3.2 Plate inclined to the jet
- 2.4 Force exerted by fluid jet on stationary curved vane
 - 2.4.1 Jet strikes at the centre of symmetrical curved vane
 - 2.4.2 Jet strikes tangentially at one
- 2.5 Force exerted by a fluid jet on moving curved vane.

3. Hydraulic Turbines :

- 3.1 Classification of water turbines
- 3.2 Pelton turbine
 - 3.2.1 Working principle
 - 3.2.2 Constructional features
- 3.3 Francis turbine and Kaplan turbine
 - 3.3.1 Working principle
 - 3.3.2 Constructional features
- 3.4 Draft tube
- 3.5 Cavitation
- 3.6 Governing of Turbines
 - 3.6.1 Need for governing
 - 3.6.2 Simple governing mechanism
- 3.7 Surge tank
- 3.8 Turbine performance
 - 3.8.1 Heads - gross, net
 - 3.8.2 Efficiency - Hydraulic, Mechanical, Volumetric, Overall
 - 3.8.3 Unit quantities
 - 3.8.4 Specific speed
 - 3.8.5 Introduction to characteristics curve (no numerical problems)

3.9 Numerical problems on turbines

4. Centrifugal Pump :

4.1 Introduction and working principles

4.2 Advantages over reciprocating pump

4.3 Classification

4.4 Constructional features

4.4.1 Mechanical manometric and overall efficiency

4.5 Head of a pump - static, manometric

4.5.1 Power required to drive the pump

4.6 Losses in pump and efficiency

4.7 Minimum starting speed

4.8 Pumps in series and parallel

4.9 Priming

4.10 Description and working of multistage centrifugal pump, submersible, deepwell pump and gear pump.

4.11 Numerical problems

5. Reciprocating Pump :

5.1 Types of pump

5.2 Main components and working

5.3 Slip

5.3.1 Percentage slip

5.3.2 Negative slip

5.4 Work done by a reciprocating pump

5.5 Acceleration of piston

5.5.1 Its effect on velocity and pressure

5.6 Air vessel

5.7 Troubles in Reciprocating pump and their remedies.

5.8 Numerical problems

6. Miscellaneous Hydraulic Machines :

6.1 Description, working principle of following machines

6.1.1 Hydraulic accumulator

6.1.2 Hydraulic intensifier

6.1.3 Hydraulic press

6.1.4 Hydraulic coupling and torque converter

PRACTICALS

1. Determination of coefficient of friction for pipes
2. Determination of slip, coefficient of Discharge for a reciprocating pump
3. To draw characteristics curves and efficiency curves of
 - 3.1 Centrifugal pump
 - 3.2 Pelton wheel turbine
 - 3.3 Francis turbine
4. Study of model of Kaplan turbine
5. Study of submersible pump, jet pump, deepwell pump.

REFERENCE BOOKS :

- | | |
|-------------------------------|-----------------|
| 1. Fluid Mech. & Machines | Dr. Jagdish Lal |
| 2. Fluid Mech. & Machines | Dr. R.K.Bansal |
| 3. Fluid mechanics & Machines | R.S.Khurmi. |
| 4. Hydraulics & Pneumatics | H.L. Stewart |
| 5. Fluid Machines | S.S. Ratan |

FLUID POWER AND TRIBOLOGY

CODE ME 43

L T P
2 -- 2

RATIONALE

This subject covers the study of various components of a fluid power system and pneumatics, which are widely used in various machines. This also deals with various types of lubricants and their property. Various lubrication method have also been incorporated in the subject

CONTENTS

1. Introduction :

- 1.1 Basic idea about fluid power systems
- 1.2 Advantage of fluid power
- 1.3 Application of fluid power
- 1.4 Description of hydraulic power pack unit
- 1.5 Characteristics properties of hydraulic fluid

2. Hydraulic Pumps :

- 2.1 Principle of hydraulic pumps and pump capacity
- 2.2 Classification of pumps
- 2.3 Construction and working of various rotary and reciprocating oil pumps

3. Hydraulic Valves :

- 3.1 Construction and working of various types of hydraulic valves viz. flow control valves, pressure control valves, direction control, valves check valves and special valves used in fluid power system.

4. Actuators :

- 4.1 Various types of hydraulic cylinders
- 4.2 Cylinder cushioning, cylinder mountings
- 4.3 Semi rotary actuators
- 4.4 Different type of hydraulic motors, Hydraulic motor circuits

5. Accumulators and Heat Exchangers :

- 5.1 Function of hydraulic accumulators in hydraulic circuits
- 5.2 Construction and working of various types of accumulators and heat exchangers

6. Hydraulic Circuit and Devices :

- 6.1 Speed control circuit, pressure reducing circuit, sequencing circuit, reciprocating circuit, rapid traverse and feed circuit
- 6.2 Intensifier, hydraulic coupling, torque converter and power operated clamping devices
- 6.3 Fault diagnosis and preventive measures of hydraulic circuits.

7. Packing and Seals :

- 7.1 Classification of seals, static seals, dynamic seals
- 7.2 Sealing materials

8. Pipes and Pipe Fittings :

- 8.1 Study of various types of pipes, tubes and hoses used in hydraulic circuits
- 8.2 Pipe fittings
- 8.3 Cutting and bending of pipes and tubes

9. Pneumatics :

- 9.1 Various pneumatic system components viz compressors, Air filters, Regulators and lubricators
- 9.2 Different types of pneumatic valves and Actuators
- 9.3 Various pneumatic circuits and devices

10. Lubrication Principles :

- 10.1 Friction, wear
- 10.2 Necessity of lubrication
- 10.3 Dry lubrication, Boundary lubrication, hydrodynamic lubrication

11. Properties of Fluids :

- 11.1 Viscosity, temperature and pressure v/s viscosity
- 11.2 Viscosity index, flash and fire point, oiliness cloud and pour points, emulsification, specific gravity, colour etc.

12. Lubricants and Applications:

- 12.1 Lubricant sources and composition, liquid lubricants, solid lubricants, Greases etc, Lubricant additives properties of specific lubricants, selecting the lubricant under various conditions.
- 12.2 Functions of a lubricant in the following : Sliding bearings, rolling bearing, gears, chains , wire rope, metal working, seals and packing.

INTERNAL COMBUSTION ENGINE

CODE ME 44

L T P
3 -- 2**RATIONALE**

The knowledge of Thermal Engineering is essential in order to understand the working of the prime movers such as Petrol Engines, Diesel Engines gas, Turbines and Air Compressors.

CONTENTS**1. Gas Power Cycles :**

- 1.1 Otto cycle, Diesel cycle, Dual combustion cycle, Atkinson brayton cycle
- 1.2 Air standard efficiency
- 1.3 Effect of compression ratio on efficiency
- 1.4 Numerical Problems

2. Principles of Internal Combustion Engines :

- 2.1 Introduction and Classification of I.C Engines
- 2.2 Working principle of four stroke and two stroke cycle and their comparison
- 2.3 Working and special features of petrol and diesel engines and their comparison and applications
- 2.4 I.C. engine terms - Bore, stroke, dead centres, crank throw, compression ratio, clearance volume, piston displacement and piston speed, B.S.I. specification for I.C. engine parts
- 2.5 Valve timing diagrams, firing order and super charging of I.C. engines

3. Petrol Engines :

- 3.1 Concept of Carburation, Air fuel ratio
- 3.2 Simple carburetors and its limitations
- 3.3 Description of Solex and S.U. types carburetors
- 3.4 Multi point fuel injection system
- 3.5 Mechanical and electrical feed pump
- 3.6 Description of coil ignition system and Magneto ignition system
- 3.7 Elementary idea of combustion phenomenon, detonation, pre-ignition and octane number

4. Diesel Engines :

- 4.1 Description and working of Fuel feed pump
- 4.2 Injection of fuel, air and airless injection and fuel injectors

- 4.3 Elementary idea of combustion phenomenon, diesel knock, delay period and Cetane number.
- 4.4 Introduction to swirl and open combustion chambers
- 4.5 Introduction to Wankel engine

5. Cooling, Lubrication and Governing :

- 5.1 Necessity of engine cooling
- 5.2 Properties of coolants
- 5.3 Methods of cooling and their merits and demerits
- 5.4 Function of Lubrication, lubrication systems of I.C. Engines
- 5.5 Governing methods of I.C. Engines.

6. I.C. Engines Performance :

- 6.1 Introduction to basic performance parameters
- 6.2 Measurement of brake power by rope brake, prony brake and hydraulic dynamometer
- 6.3 Measurement of Indicated power by engine indicator and Morse test method.
- 6.4 Energy balance sheet of I.C. engines
- 6.5 Numerical problems

8. Gas Turbines :

- 8.1 Classification and application of gas turbines
- 8.2 Description of constant pressure (open cycle and closed cycle) and constant volume gas turbines.
- 8.3 Methods of increasing thermal efficiency of gas turbines, regeneration, inter cooling, re-heating.
- 8.4 Simple numerical problems

PRACTICALS

1. Dismantling and Assembly of - Two-stroke petrol engine, study of various systems, replacement of packing and gaskets, tuning of carburetor setting of magneto points. Checking of engine after assembly for proper running.

2. Dismantling and Assembly of -

- 2.1 4-stroke diesel engine
- 2.2 Multi cylinder petrol engine - Adjustment of valve timing, Tappet adjustment, tuning of carburetor, Adjustment of pressure in injector, Checking of engine after assembly for proper running.

3. Dismantling and Assembly of -

- 3.1 Scooter carburetor
- 3.2 Solex carburetor
- 3.3 S.U. Carburetor
- 3.4 Study of flow diagram of different jet circuits, practice of various adjustments.

4. Dismantling and Assembly of - A. C.mechanical and electrical feed pumps of a petrol engine

5. Dismantling and assembly of diesel engine fuel pumps and injector Various adjustment, Fitting and cleaning of their filters.
6. To draw the energy balance sheet of diesel engine. Use of indicator diagrams to find I.P. determining various efficiencies.
7. To draw energy balance sheet of a multi cylinder petrol engine (I.P. by Morse test). Determining various efficiencies.
8. To draw energy balance sheet of single cylinder petrol engine and draw efficiency and sfc curves.
9. Study of an air compressor and to conduct performance test.

REFERENCE BOOKS :

- | | |
|-----------------------------------|-----------------|
| 1. Internal Combustion Engine | Mathur & Sharma |
| 2. Thermal Engineering (In Hindi) | Verma & Gulecha |
| 3. Thermal Engineering Vol 1 | Mathur & Metha. |
| 4. Thermal Engineering | R.S. Khurmi |
| 5. Thermal Engineering | R.K.Purohit |

WORKSHOP TECHNOLOGY - I

CODE ME 45
MA 45

L T P
2 -- 6

RATIONALE

This subject would impart the knowledge of various production machinery. The knowledge of metal cutting would help the student in acquiring requisite skills to open up his own workshop or in an industry.

CONTENTS

1. Cutting Tools and Materials :

1.1 Cutting tools

- 1.1.1 Standard shape of single point tool
- 1.1.2 Cutting angles, effect of rake angle, importance of clearance angle
- 1.1.3 Heat produced by cutting and its effect
- 1.1.4 Cutting speed, feed and depth of cut

1.2 Materials

- 1.2.1 Materials of cutting tools and their properties
- 1.2.2 High-speed steel, cobalt steel, tungsten carbide, cemented carbide, stellite, diamond, ceramics.

2. Lathe Machine :

- 2.1 Specifications, Classification of lathe machines
- 2.2 Constructional features of a centre lathe and its function
- 2.3 Functions of various parts of lathe
- 2.4 Different operations, which can be performed on the centre, lathe with and without attachments.
- 2.5 Calculation of gear trains for thread cuttings
- 2.6 Lathe attachments and lathe accessories.

3. Drilling Machines :

- 3.1 Description, working and uses of different drilling machines, Multi spindle drill, gang drill, deep hole drill and small diameter hole drill machines.
- 3.2 Specifications and constructional features of radial arm and upright drilling machines
- 3.3 Work holding devices, tool holding devices
- 3.4 Description and types of drills and reamers

- 3.5 Various operations of drilling machines e.g. drilling, reaming, boring, counter-boring, counter sinking, spot facing, tapping.
- 3.6 Selection of drill
- 3.7 Cutting speed and feed according to material of job.

4. Shaping, Planning and Slotting Machines :

- 4.1 Description, working and uses of various types of shapers, planers and slotters
- 4.2 Specification, constructional features of a shaper and planner in detail
- 4.3 Mechanism used in shaper - crank and slotted link, whitworth quick return and hydraulic mechanism, Feed mechanism
- 4.4 Mechanism of planner
- 4.5 Various works holding devices and clamping devices used on shaper and planner
- 4.6 Various shaper and planner operations
- 4.7 Shaper and planner tools
- 4.8 Cutting speed, feed and depth of cut on shaper and planner
- 4.9 Difference between shaper, planner and slotter

5. Cutting Fluids and Cooling Process :

- 5.1 Difference between cutting fluid and coolant
- 5.2 Functions of cutting fluid and its action
- 5.3 Requirements of good cutting fluid
- 5.4 Types of cutting fluids
- 5.5 Selection of cutting fluids for different material and operations.

PRACTICALS

- 1. Grinding of various types of single point cutting tool
- 2. Simple exercise on Lathe Machine involving following operation
 - 2.1 Simple turning, facing, step turning, Grooving and knurling and taper turning, by compound rest
 - 2.2 Facing, drilling, boring and step turning, parting off.
 - 2.3 Taper turning by tails tock off set method
 - 2.4 V threading, square threading and taper threading by attachment
 - 2.5 A utility job on lathe machine with an accuracy of ± 0.2 mm
- 3. Preparing a M.S. block with all faces finished and V grooved on shaper machine
- 4. Planning practice on a planner on a rectangular C.I plate.
- 5. Internal slot cutting on the slotter machine

REFERENCE BOOKS :

- | | |
|-------------------------------------|--------------------|
| 1. Workshop Technology (Hindi) - II | Tahil Manghnani |
| 2. Workshop Technology (Hindi) - II | B.S.Raghuvanshi |
| 3. Workshop Technology - II | Hazra & Chaudhary. |
| 4. Workshop Technology (Hindi) | S.K.Bhatnagar |
| 5. Production Technology | R.K. Jain |
| 6. All About M/C Tools | Gerling |

METROLOGY

CODE ME 46
MA 46

L T P
2 -- 2

RATIONALE

Technicians have to carry out the job of measurement and inspection in the factories for controlling the quality of products. Therefore they must have the knowledge of science of measurements or metrology. They must be familiar with the concept and technique of inspection and quality control methods.

This subject i.e. Metrology has been designed to impart all the related and concerned knowledge to the student to fulfill the need.

The content of syllabus broadly includes linear and angular measurement of surfaces, measurements by comparators, light wave interferometry, gear, screw measurements and inspection.

Finally, to develop the skill in measurement a list of practicals is also given which should be carried out by the students in metrology laboratories.

CONTENTS

1. Introduction :

- 1.1 Units and standards of measurement
- 1.2 International, National and company standards
- 1.3 Line and end standards
- 1.4 Errors in measurement
- 1.5 Precision and accuracy

2. Linear and Angular Measurement :

- 2.1 Vernier calliper, micrometers, height and depth gauges
- 2.2 Bevel protractor, sine bar, slip gauges, angle gauges and clinometers
- 2.3 Auto collimator, angle dekkar,
- 2.4 Taper measurements
- 2.5 Cylinder bore gauge, Telescopic gauge, feeler and wire gauge

3. Measurement of Surface Finish :

- 3.1 Meaning of surface texture, primary and secondary texture
- 3.2 Terminology of surface roughness
- 3.3 Factors affecting surface finish
- 3.4 Representation of surface roughness parameters CLA and RMS values

3.5 Comparison and direct instrument methods of surface finish measurements.

4. Comparators :

4.1 Classification, advantages and working mechanism of dial indicators, passmeters

4.2 Mechanical, Electrical, Electronic and pneumatic comparators

5. Light Wave Interference :

5.1 Principle of interference

5.2 Interferometry applied to flatness testing

5.3 N.P.L. flatness interferometer

6. Gear and Screw Measurement :

6.1 Screw thread terminology, errors in threads

6.2 Effective diameter measurement by two wire and three wire methods

6.3 Major and minor diameter measurement, Thread micrometers

6.4 Gear tooth terminology

6.5 Gear tooth vernier calliper and its application

6.6 Measurement of gear pitch.

7. Limits, Fits and Tolerance :

7.1 Interchangeability - control and need

7.2 Definitions and Terminology of limits, fits and tolerances

7.3 Basis of limit system

7.4 Type of fits

7.5 Limit gauges

8. Machine Tool Metrology :

8.1 Alignment tests

8.2 Performance tests

8.3 Alignment test on lathe and drilling machine

9. Inspection :

9.1 Inspection - concept, need and methods

9.2 Types of inspection.

PRACTICALS

1. Internal and External measurement with the vernier calliper

2. Internal and External measurement with micrometer

3. Measurement with height and depth gauges.
4. Measurement with dial indicator using surface plate and accessories for -
 - 4.1 Flatness
 - 4.2 Concentricity
5. Measurement with combination set and bevels protractor
6. Measurement of thread characteristics
7. Study and use of slip gauges
8. Study of limit gauges.
9. Internal and External taper measurement.
10. Measurement of gear characteristics
11. Measurement of angle with sine bar and slip gauges
12. Study and use of comparators
13. Study and use of tool room microscopes.
14. Measurement of bore with cylinder dial gauge for ovality and taper.
15. Measurement of worn out I.C. Engine piston, clearance between cylinder and piston and between bearing and journal

Note : Industrial visit can be arranged to show these practicals to the students.

REFERENCE BOOKS :

- | | |
|------------------------------------|---------------|
| 1. Engineering Metrology | R.K.Jain |
| 2. Engineering Precision Metrology | R.C.Gupta |
| 3. Engineering Metrology (Hindi) | Mittal |
| 4. Engineering Metrology (Hindi) | Bhatnagar. |
| 5. Engineering Metrology | R.K.Rajput |
| 6. Metrology Lab Manual | Adithen, Bahl |
| 7. Metrology | M. Mahajan |

THEORY OF MACHINES

CODE ME 47
MA 47

L T P
3 2 --

RATIONALE

An engineer should be well acquainted with the motion of mechanism of different machine element. With this view the study of Theory of machine is very much important.

The contents of this subject include simple mechanism, kinematics of machine, dynamics of reciprocating parts, friction involved in the machine elements, power transmission, governors, balancing and vibrations in machine.

CONTENTS

1. Simple Mechanism :

- 1.1 Introduction to link, kinematic pair, kinematic chain, structure, mechanism, machine
- 1.2 Slider crank mechanism and its inversion
- 1.3 Double slider crank chain
- 1.4 Example of mechanism with higher pairs

2. Velocity and Acceleration in Mechanism :

- 2.1 Velocity diagrams of four bar and single slider crank mechanisms by relative velocity method and instantaneous centre method
- 2.2 Acceleration diagram of four bar chain and reciprocating engine mechanism

3. Dynamics of Reciprocating Parts :

- 3.1 Analytical method for velocity and acceleration of piston
- 3.2 Piston effort, crank pin effort, turning moment diagrams
- 3.3 Fluctuation of energy and speed
- 3.4 Energy of a flywheel
- 3.5 Calculating the weight of flywheel.

4. Friction :

- 4.1 Friction of collars and pivots
- 4.2 Friction clutches-plate clutch and centrifugal clutch
- 4.3 Friction in journal bearings

- 4.4 Rolling friction
- 4.5 Prony brake, Rope brake and Froude's hydraulic dynamometer.

5. Transmission of Power :

- 5.1 Flat and V-belt drives
- 5.2 Velocity ratio of belt drives, slip in belt, and creep in belt.
- 5.3 Length of open and cross belt drives
- 5.4 Power transmitted by a belt
- 5.5 Ratio of driving tension, centrifugal tension, Condition for the maximum power transmission, initial tension in the belt.
- 5.6 Chain drives - types of chain drives roller chain and inverted tooth chain.
- 5.7 Gear drives - Types of gear wheels, proportions of gear tooth
- 5.8 Gear trains - Simple gear train, compound gear train, reverted gear train and simple epicyclical gear train.

6. Balancing :

- 6.1 Static and dynamic balancing
- 6.2 Balancing of single rotating mass by a single mass in the same plane, by two masses rotating in different planes.
- 6.3 Partial primary balancing of a single cylinder reciprocating engine

7. Vibration :

- 7.1 Causes of vibrations in machine, their effects and method of reducing them
- 7.2 Free or natural vibration
- 7.3 Forced vibration
- 7.4 Damped vibration.

REFERENCE BOOKS :

- | | |
|-----------------------|-----------------|
| 1. e'khu dk fl)kar | diwj ,oa dqekj |
| 2. Theory of Machines | Jagdishlal |
| 3. Theory of Machines | R.S.Khurmi |
| 4. Theory of Machines | Abdullah Sharif |
| 5. Theory of Machines | Malhotra, Gupta |
| 6. Theory of Machines | S.S. Ratan |
