Fourth Semester

Strength of Materials (DME-401)

Discipline core (DC): Credit 4(3-0-2)

Objective: Diploma holders in this course are required to analyses reasons for failure of different components and select the material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced.

COURSE OUTLINE:

1. Introduction to Material Properties 03 Period

Mechanical properties of materials such as elasticity, plasticity, ductility, brittleness, toughness, hardness, fatigue, malleability, stiffness. Elastic bodies, plastic bodies and rigid bodies, deformation.

2. Stresses and Strains 08 Period

2.1 Force, its definition and types, units, different types of loads.

2.2 Definition of stress and strain, axial loading, different types of stresses and strains, tensile and compressive stress and strain, elastic limit, Hooke's law, stress-strain curve for ductile and brittle material, salient features of stress-strain curve. Young's modulus of elasticity

2.3 Factor of safety.

2.4 Stress and strain in straight, stepped bars and taper bar of circular cross section, determination of stress and elongation of a bolt in a bolted joint when subjected to direct external load only

2.5 Stress and strain on composite section under axial loading, stress and strain due to temperature variations in homogeneous and composite bars.

2.6 Shear load, shear stress and strain, modulus of rigidity, lateral strain, Poisson's ratio

2.7 Volumetric strain, bulk modulus. Relation between modulus of elasticity, modulus of rigidity and bulk modulus

3. Shear Force and Bending Moment 06 Period

3.1 Types of beams.

3.2 Concept of shear force and bending momen.

3.3 Shear force and bending moment diagram for cantilever and simply supported beams subjected to point load and uniformly distributed loads only. Maximum bending moment and point of contraflexure.

4. Theory of Simple Bending 06 Period

4.1 Concept of pure bending, neutral axis, moment of resistance, section Modulus, bending equation, bending of simple, beams of uniform strength.

4.2 Application of flexural formula for solid rectangular and circular section, Channel section, hollow rectangular and circular section.

5. Strain Energy 06 Period

5.1 Concept of strain energy, proof resilience and modulus of resilience.

5.2 Stresses developed due to gradual, sudden and impact load.

5.3 Strain energy stored due to gradual, sudden and impact load.

5.4 Strain energy due to bending and torsion.

6. Slope and Deflection 06 Period

6.1 Introduction, determination of slope and deflection by Macaulay's method, moment area of method

6.2 Simple cases of slope and deflection in simply supported beam with uniformly distributed load on whole of the length and a point load at the centre

6.3 Cantilever beam with uniformly distributed load on whole length and a point load at the end.

7. Torsion 05 Period

7.1 Pure torsion, torsion equation (relation between twisting moment, shear stress and angle of twist), polar modulus of section

7.2 Assumptions in theory of pure torsion

7.3 Strength of circular solid shaft and hollow shaft in pure torsion

7.4 Power transmitted by shaft

8. Springs 05 Period

8.1 Effect of falling load helical spring

8.2 Helical Springs closed coiled and open coiled helical springs subjected to axial load

8.3 Angle of twist, strain energy, shear stress and maximum deflection under axial load

8.4 Laminated spring (semi-elliptical and quarter-elliptical type), deterination of number of plates, maximum deflection under axial load

9. Thin Cylinder and spheres 07 Period

9.1 Introduction

9.2 Thin cylinder Vessel Subjected to internal Pressure

9.3 Stresses in a Thin cylinder Vessel Subjected to internal Pressure

9.4 Expression for circumferential stresses

9.5 Expression for longitudinal stresses

9.6 Stresses in a Thin cylinder Vessel Subjected to internal Pressure and external pressure

9.7 Stresses in a thin sphere shells subjected to internal Pressure

10. Riveted Joints 06 Period

10.1 Introduction

10.2 Types of rivets joints

10.3 Failure of riveted joints

10.4 Strength of the riveted joints

10.5Efficiency of riveted joints

LIST OF PRACTICALS

1. Tensile test on bars of mild steel and aluminum
2. Shear test on specimen of two different metals
3. Impact test on metals (a) Izod test (b) Charpy test
4. Torsion test on specimens of different metals for determining the angle of twist for a given torque
5. To determine the stiffness of a helical spring and to plot a graph between load and extension
6. Hardness test on metal and finding the Rockwell hardness

RECOMMENDED BOOKS

1. Strength of Materials by Srivatava & Gope, PHI Publication.
1. Strength of Materials by R.S. Khurmi; S. Chand and Company, Delhi.
2. Strength of Materials by S. Ramamurtham; Dhanpat Rai Publishing Co.(P) Limited, Delhi.

APPLIED THERMAL ENGINEERING (DME-402)
Discipline core (DC): Credit 4(3-0-2)

Objective: Thermal energy is still a major means of power in the world. Knowledge of thermal contrivances and related principle is very essential for mechanical diploma holders. The subject presents an introduction to sources of heat, thermodymics principles and their applications to thermal contrivances.

COURSE OUTLINE:

Unit I

IC engine and air standard cycles: Introduction, classification of I C engines, comparison of S I and C I engines, two stoke and four stroke engines, working principle and valve timing diagram of four stroke, two stroke petrol and diesel engines, Air standard cycles: Carnot cycle, Derivation of thermal efficiency and mean effective pressure of Otto cycle, Diesel cycle and dual cycle, simple numerical problems on above topics

Unit II

System in IC Engines: Carburetion: Carburettor and its function, A/F mixture requirements under different loads, working principle of simple carburetor Ignition systems: Requirement of ignition system, Battery ignition system, magneto ignition system, spark plug, firing order Cooling systems: Necessity of cooling, types, liquid cooled system, air cooled system Lubrication system: Function of lubrication, crankcase ventilation

Unit III

Combustion in IC Engines: Combustion in S I engines: Stages of combustion, flame front propagation, factors influencing the flame speed, phenomenon of knock Combustion in C I engines: Stages of combustion, ignition delay, factors affecting delay period, phenomenon of knock

Unit IV

Air Compressor, Jet propulsion: Air compressor: Classification, reciprocating compressor, effect of clearance volume, volumetric efficiency, work input in single and multi stage compression, simple numerical problems, Working principle of root blower, vane blower, centrifugal and axial compressors Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines their processes, Principle of rocket propulsion

Unit V

Engine Emissions and Alternative fuels: Emissions: Air pollution due to I C engines, Bharat stages and EURO norms of emissions, study of catalytic converter Alternative fuels: Methanol, Ethanol, Bio diesel, Hydrogen, compressed natural gas (CNG), liquefied petroleum gas (LPG)

LIST OF PRACTICALS

1. Study of working principle of two/ four stroke petrol engines.
2. Study of simple/ compound carburetor.
3. To determine brake horse power by dynamometer.
4. To determine indicated horse power of a multicylinder petrol/diesel engine.
5. To prepare that balance sheet of diesel/ petrol engines
6. To study a vapour compression/ absorption refrigeration system
7. Study a cold storage through a visit
8. Study a room air conditioner
9. Study of cooling system of I.C. engines
10. Study of lubrication system of four stroke I.C. engine

RECOMMENDED BOOKS

1. Elements of heat engines by Pandey and Shah; Charotar Publishing house, Anand
2. Thermal Engineering by PL.Ballaney; Khanna Publishers, New Delhi.

BASIC CIVIL ENGINEERING (DME-403)

Basic Engineering and Science (BES) Core: Credit 4(3-0-2)

COURSE OUTLINE:

1- Construction material **(08 period)**

Basics of various construction materials such as stones,bricks,lime,cement,steel and timber along with their properties, physical/field testing and uses, elements of brick and stone masonry.

2- Foundations Engineering **(08 period)**

I) Various types of soil

II) Bearing capacity of soil and its importance

III) Types of various foundations for heavy, light and vibrating machines

3- Basic concept of concrete **(08 period)**

Various ingredients of concrete, physical properties of aggregate as constituent material of concrete, different grade of concrete, water cement ratio, workability, physical/field testing of concrete, mixing of concrete , Introduction to IS: 456-2000, IS: 800-2007 and NBC 2005 (SP-7: 2005)

4- RCC **(06 period)**

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building, design of plain concrete strap footing.

5- Steel structure **(06 period)**

Various types of steel, various rolled steel sections and their properties, use of steel table, introduction to riveted and welded connections.

6- Environmental engineering (04 period)

Various sources of water, parameters related to qualities of portable water, impurities in water, introduction to various methods of water treatment.

7- Surveying

Introduction to surveying, representation to scale, introduction to chain surveying, traversing and plain table surveying , introduction to leveling , introduction to contouring and its properties.

PRACTICAL EXERCISES IN CIVIL ENGINEERING

1- Testing of bricks:(a)Shape & Size (b)Soundness Test (c)Water Absorption (d)Crushing Strength

2- Testing of Concrete:(a)Slump Test (b)Compressive Strength of concrete cube.

3- Testing of Aggregates:

(a)Impact Test (b)Abrasion Test

4- Testing of Sand:(a)Field test of physical impurities of sand

5- Testing on Steel:(a)Tensile Strength Test of steel bars

6- Surveying Test:(a)Ranging with rod (b)Determination of reduced level (R.L.) of a point using Dumpy Level. (c)Measurement of bearings & internal angles of a traverse using Prismatic Compass

PRODUCTION TECHNOLOGY (DME-404)
Discipline core (DC) : Credit 4(3-0-2)

Objective: This subject provides knowledge and develops skills on various machine operations viz capstan and turret Lathe, milling, grinding, gear manufacturing, broaching and automatic machines which is very essential for Mechanical diploma holders to work in manufacturing industries.

COURSE OUTLINE:

1. Introduction ,study and uses of Capstan and Turret Lathe , Turret indexing mechanism, Bar feeding mechanism, Work holding devices and Tool holding devices –Jaw and collet chucks –Slide tool holder, Knee tool holder, knurling tool, holder, recessing tool holder, form tool holder, tap and die holder, V -steady box tool holder, roller steady, box tool holder, bar stops.

2: Introduction tooling layout, Comparison of capstan, turret and conventional lathe. Specification, Classification and working principle of milling machine applications of milling machines, up milling and down milling, Milling operations –face milling, angular milling, form milling, straddle milling and gang milling.

3: Grinding , Various elements of grinding wheel –Abrasive, Grade, structure, Bond, Grinding methods –Surface grinding, cylindrical grinding and center less grinding. Gear Manufacturing Processes , Gear hobbing, Gear shaping, Broaching , Introduction Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down. Elements of broach tool, broach teeth details –nomenclature, types, tool material.

4:Metal Forming Processes, Press Working, Press working –Types of presses, type of dies, selection of press die, die material, Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping, Forging, Open die forging, closed die forging, Press forging,

Extrusion and Drawing, Type of extrusion- Hot and Cold, Direct and indirect, Pipe drawing, tube drawing

5: UNCONVENTIONAL MACHINING PROCESSES-Introduction, principle, process and application of Ultrasonic machining (USM) ,Electro chemical machining (ECM) ,Electro chemical Grinding (ECG), Electrical Discharge Machining (EDM), Laser beam machining (LBM), Electro beam machining (EBM), Plasma arc machining (PAM)

Importance and use of jigs and fixture Principle of location, Types of Jigs –Drilling jigs, bushes, template jigs, plate jig, channel jig.

6: Fixture for milling Advantages of jigs and fixtures, Plastic Processes Injection Blow moulding – working principle, advantages and limitations, Compression moulding ,Metallic and Non Metallic Coating Processes, powder process, Metal Finishing Processes, Lapping process, lapping compounds and tools, Brief idea of lapping machines, Super finishing process, its applications. Production of metal powders, sintering and finishing operations and extrusion Advantages, limitations and applications of powder metallurgy.

PRACTICAL EXERCISES

1. Preparation of a drilling jig.
2. Preparation of a milling fixture.
3. Exercise on milling- slab milling, Gang milling and straddle milling
4. To produce a gear by indexing device on a milling machine
5. Preparing job on following machines:-a) Surface grinder ,b) Cylindrical grinder
6. Exercise on tool and cutter Grinder a)To grind Lathe tools b)To grind a drill bit c)To grind a milling cutter

RECOMMENDED BOOKS

1. Manufacturing technology by Rao; Tata McGraw hill Publishers, New Delhi
2. Manufacturing technology by M. Adithan and AB. Gupta; New Age International

MATERIALS SCIENCE AND METALLURGY (DME-405)

Discipline core (DC): Credit 4(4-0-0)

Objective Materials play an important role in the construction and manufacturing of equipment/tools. Right selection of materials add to the economy, working and life of machinery. A diploma holder must be conversant with the properties, uses, availability and costs of materials used for construction/fabrication to enable him to perform his functions confidently. The subject of Materials and Metallurgy has been designed to cover the above aspects.

DETAILED CONTENTS

1. Importance of Materials

Classification: Metals and non-metals, Ferrous and non-ferrous metals and their alloys
Names of common metals, their alloys and non-metals used inIndustry
Properties of metals and alloys
Physical properties - Appearance, luster, colour, density and melting point
Mechanical Properties: Strength, stiffness, elasticity, plasticity, toughness, ductility, malleability, brittleness, hardness, fatigue and creep.
Thermal and electrical conductivity Corrosion, causes, effects and prevention.

2. Metallurgical Considerations

Solidification of metals form liquid to solid state of pure metals, cooling curves of pure metals, dendritic solidification, crystal formation, types of crystal structure. Phase diagram of:
(i) Solid-state solubility.
(ii) Partial solubility.

1. Nil solubility i.e. eutectic solution (Binary only).

Effects of all alloying elements on engineering materials. Effect of grain size on mechanical properties.

3. Ferrous Metals and Alloys

Flow diagram for the production of ferrous metals from their ores, constituents of iron, iron carbon diagram.

Classification, composition and uses of cast iron and plain carbon steels. IS, BS and SAE Grades

Effect of alloying elements such as Aluminium, chromium, Nickel, Cobalt, Manganese, Molybdenum, tungsten, Vanadium, Silicon, Sulphur and Phosphorous on steels.

Composition, properties, grades and uses of special steels such as High speed steel, Stainless steels, Silicon steels, Heat resistant steels, Spring steel.

Heat Treatment: Iron-carbon diagram, objectives and practical aspects of heat treatment. Brief description and uses with examples of principal heat treatment processes, Annealing, Normalizing, Tempering, Hardening, Carburising, Nitriding and Cyaniding and applications. Examples in heat-treating engineering components time, temperature transformation curve.

4. Non-ferrous Metals and Alloys

Copper: Properties and uses Composition, properties and uses of copper alloys.

Brasses: Cartridge brass, Nickel silver.

Bronzes: Phosphor bronze, Al-bronze, Mn-bronze, and Gun metal.

Properties and uses of Aluminium. Composition, properties and uses of Al-alloys e.g., Duralumin, Yellow metal, Magnalium and Hindalium

Properties and uses of alloys of lead, tin and magnesium.

Bearing Metals: Requisite qualities. Composition, properties and uses of white metal bearing, copper based bearing metals. Aluminium based bearing metals. Use of nylon/PTFE for bushes/bearings, bimetallic and tri-metallic bushes

5. Identification and Examination of Metals and Alloys Identification tests - Appearance, sound, filing, weight, magnetic, spark, bend and microstructure. Different types of etchants for preparation of surface structure.

6. Other Important Materials

Plastics: Definition, classification of plastics, fibre glass, reinforced plastics. Major applications of various plastics and their uses and grades.

Composite materials. Heat insulating materials: Properties and uses of asbestos, glass wool, thermocole, cork, mica.

Electrical insulating materials. Properties and uses of china clay, leather, bakelite, ebonite, glass wool, rubber, felt.

Sound insulating materials: Cork, fibre boards.

Fabrication materials: Wood, plywood, rubber – natural and synthetic, Glass – plate glass, toughened glass, safety glass.

Refractory materials: General characteristics and uses of dolomite, ceramics.

Protective coating materials: Paints, primers, varnishes, enamels, putti, electroplating materials, rubasil, teflon coating.

Sealant and adhesives – Application and availability of sealant and adhesives for industrial user.

7. Selection, specifications and commercial availability of materials

Practical considerations for selection of material for different purposes, ISO/Bureau of Indian standard specifications for metals, non-metals, various components and materials.

RECOMMENDED BOOKS

1. Material Science by GBS Narang, Khanna Publishers, New Delhi.
2. Material Science and Metallurgy by RB Choudary, Khanna Publishers, New Delhi.
3. Material Science by RK Rajput; SK Kataria and Sons, Delhi.
4. Materials and Matallurgy by D.S. Nutt. SK Kataria and Sons, Delhi.

METROLOGY (DME-406)

Discipline core (DC): Credit 3(3-0-2)

Objective: Diploma holders in these courses are required to measure and inspect for ensuring quality of product. For this purpose, knowledge and skills about standards of measurement, limit, fits and tolerances, types of inspection and various measuring instruments are required.

COURSE OUTLINE:

1. Introduction 06 Period

1.1 Definition of metrology
1.2 Standard of measurement - Primary, secondary, Tertiary and working standards.
1.3 Types of errors- Controllable and random errors
1.4 Precision, accuracy, sensitivity, hysterisis, response time, repeatability, calibration, uncertainty of measurement

2. Linear Measurement 10 Period

2.1 Construction features and use of instruments for non-precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block.
2.2 Construction features and use of instruments for precision measurements: vernier calipers, vernier height and depth gauges, micrometers.
2.3 Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges.
2.4 Cylinder bore gauges, feeler and wire gauges.
2.5 Comparators – Characteristics, uses, working principles of different types of comparators: mechanical, electrical, electronics and pneumatic comparator.

3. Angular Measurement 09 Period

3.1 Construction and use of instruments for angular measurements: bevel Protector, sine bar, angle gauges, clinometers.
3.2 Optical instruments for angular measurement, autocollimator. Angle dekkors
3.3 Circular divisions - optical dividing heads, circular dividing engine, rotary tables, other instruments

4. Measurement of Surface Finish 08 Period

4.1 Terminology of surface roughness.
4.2 Concept of primary texture and secondary texture.
4.3 Factors affecting surface finish.
4.4 CLA, RMS and RA value.
4.5 Principle and operation of stylus probe instruments for measuring surface
Roughness

5. Measurements of Screw threads and Gears 08 Period

5.1 Measurement of screw threads- Introduction, measurements of external and core diameters, checking of pitch and angle of threads with gauges.
5.2 Effective diameter measurement by three wire method.
5.3 Measurements of gears (spur) – Measurement of tooth thickness, pitch, testing of alignment of teeth.
5.4 Profile projector, Coordinate Measuring Machine (CMM), Tool maker's microscope.

6. Machine Tool Testing 08 Period

6.1 Alignment test on lathe, drilling machine and milling machine.

7. Limits, Fits and Tolerances 07 Period

7.1 Definition and terminology of limits, fits and tolerances.
7.2 Interchangeability
7.3 Hole basis and shaft basis systems.
7.4 Type of fits.
7.5 Standard and Limit gauges.

LIST OF PRACTICALS

1. Internal and external measurement with vernier - caliper and micrometer.
2. Measurement with height gauge and depth gauge.
3. Measurement of flatness with dial indicator.
4. Measurement with combination set and bevel protector.
5. Study and use of slip gauges.
6. Measurement of gear characteristics
7. Measurement of angle with sine bar and slip gauges
8. Measurement of worn out IC engine piston clearance between cylinder and piston.
9. Measurement of flatness using comparator.
10. Determination of temperature by
(i) pyrometer (ii) thermocouple.
11. Use of feeler gauge, wire gauge, radius gauge and fillet gauges for checking of standard parameters.
12. Measurement of surface roughness of a surface

RECOMMENDED BOOKS

1. Engineering Metrology by RK Jain; Khanna Publishers, New Delhi.
2. A Text Book of Production Engineering by PC Sharma; S Chand and Company,
New Delhi.