

3.1 STRENGTH OF MATERIALS

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RATIONALE

Diploma holders in this course are required to analyse reasons for failure of different components and select the required materials 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. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles to the solution of applied problems to develop the required competencies.

DETAILED CONTENTS

1. Stresses and Strains (6 hrs)
 - Concept of load, stresses and strain
 - Tensile, compressive and shear stresses and strains
 - Concept of elasticity, elastic limit and limit of proportionality
 - Hooke's Law, Young's Modulus of elasticity, Yield point, plastic stage, Strain hardening, Stress strain diagram, Ultimate strength and breaking stress, Percentage elongation, Principle of superposition, Free body diagram, Proof stress and working stress, Factor of safety, Bars of varying cross-section, Temperature stresses and strains, Composite sections under compression and tension, Lateral strain, Poisson's ratio, Numerical Problems.

2. Resilience and Instantaneous Stress (5 hrs)
 - Concept of resilience, proof resilience and co-efficient of resilience
 - Modes of loading: gradual loading, sudden loading and falling load
 - Calculation of instantaneous stress induced due to gradual loading, sudden load and falling loads
 - Numerical problems on the above

3. Beams and Bending Stress (8 hrs)
 - Concept of beams
 - Types of beams
 - Types of loading
 - Concept of end supports – Roller, hinged and fixed
 - Concept of bending moment and shearing force
 - Bending moment and shearing force diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and UDL. Point of contraflexure.
 - Numerical problems

4. Moment of Inertia (6 hrs)
- Concept
 - Second moment of area
 - Radius of gyration
 - Theorem of parallel axes
 - Theorem of perpendicular axes
 - Section modulus
 - Moment of inertia of plane figures such as rectangle, square, triangle, circle, trapezium (without proof)
 - Numerical problems on: Angle section, T section, I section, circular section, channel section, Z section, hollow section and removed section
5. Bending Stress (7 hrs)
- Concept of bending stresses
 - Theory of simple bending, assumptions made in bending theory
 - Use of equation $\sigma/y=M/I=E/R$
 - Concept of moment of resistance
 - Bending stress diagram
 - Calculation of maximum bending stress in beams of rectangular, I and T sections
 - Permissible bending stress, section modulus for rectangular, circular and symmetrical I sections
6. Springs (4 hrs)
- Determination of number of plates
 - Maximum bending stress and deflection
 - Closed coil helical spring subjected to axial load
 - Stress deformation
 - Stiffness and angle of twist and strain energy
 - Falling loads on springs
 - Numerical problems
7. Columns (5 hrs)
- Concept of column, modes of failure
 - Types of columns
 - Buckling load, crushing load
 - Slenderness ratio
 - Factors effecting strength of a column
 - End restraints
 - Effective length
 - Strength of column by Euler Formula without derivation
 - Rankine Gourdan formula (without derivation)
 - Numerical problems

8. Torsion (7 hrs)
- Concept of torsion, difference between torque and torsion
 - Derivation and use of torque equation
 - Shear stress diagram for solid and hollow circular shaft
 - Comparison between solid and hollow shaft with regard to their strength and weight
 - Power transmitted by shaft
 - Concept of mean and maximum torque
 - Numerical problems

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 R.S. Khurmi; S. Chand and Company, Delhi.
2. Strength of Materials by DR Malhotra, Satya Prakashan, Delhi.
3. Strength of Materials by RK Rajput, SK Kataria and Sons, Delhi
4. Strength of Materials by Birender Singh.
5. Strength of Materials by Dr. Sadhu Singh.

3.2 PRINCIPLES OF THERMAL ENGINEERING

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RATIONALE

A diploma holder in Mechanical Engineering (Fabrication Technology) is supposed to maintain I.C. Engines, Compressors and other power plant equipment. Therefore, it is essential to teach him concepts, principles and applications of basic thermodynamics, basic air cycles, types of fuels used and compressors and components of refrigeration and air-conditioners. Hence this subject.

DETAILED CONTENTS

1. Principles of Thermal Engineering (04 hrs)
 - 1.1 Introduction
 - 1.2 Thermodynamics properties – intensive and extensive
 - 1.3 Property, path, process, system, surroundings
 - 1.4 Heat and work
 - 1.5 Enthalpy and internal energy

2. Gas Laws (04 hrs)

Boyle's law, Charle's law, Joule's law, Characteristic gas equation, gas constant, universal gas constant. Simple numerical problems

3. Law of Thermodynamics (06 hrs)
 - 3.1 Zeroth law of thermodynamics
 - 3.2 Irreversible process
 - 3.3 First law of thermodynamics (concept only)
 - 3.4 Limitations of first law of thermodynamics
 - 3.5 Second law of thermodynamics (concept only)
 - 3.6 Thermal efficiency and heat pump, heat engine and heat sink
 - 3.7 Concept of entropy
 - 3.8 Constant volume, constant pressure, isothermal, hyperbolic, adiabatic, polytropic, throttling and free expansion processes.
 - 3.9 Application of steady flow energy equation to turbine, pump, compressors, nozzle, and evaporator

4. Air Cycles (06 hrs)
 - 4.1 Carnot cycle

- 4.2. Otto cycle
- 4.3. Diesel cycle
- 4.4. Dual combustion cycle
- 4.5. Simple numerical problems
- 5. Fuels and Combustion (05 hrs)
 - 5.1 Types of fuels
 - 5.2 Properties of fuel, Calorific value of fuels
 - 5.3 Fuel combustion
 - 5.4 Air requirement for complete combustion of fuel
 - 5.5 Fuel gas analysis
 - 5.6 Alternative fuels for automobiles- CNG,LPG, Bio-diesel
- 6. Air Compressors (06 hrs)
 - 6.1 Reciprocating air compressor
 - 6.2 Centrifugal compressor
 - 6.3 Working of single stage and double stage compressor and applications
 - 6.4 Rotary air compressor
 - 6.5 Working of fan, blower, booster and super charger
 - 6.6 Principles of turbo charger
- 7. IC Engine Testing (06 hrs)

Testing of I.C. engine and determination of IHP, BHP and FHP. Mechanical efficiency and thermal efficiency, specific fuel consumption, Heat balance sheet.
- 8. Heat Transfer (05 hrs)

Modes of heat transfer, Fourier's Law, steady state conduction, composite structures. Natural and forced convection
- 9. Refrigeration and Air Conditioning (06 hrs)

Refrigeration methods, unit of refrigeration, reversed carnot cycle, heat pump, coefficient of performance, rating of refrigeration machines

Principles of air conditioning, Concept of human comfort, Introduction to air conditioning system. components of air conditioning system and their function

LIST OF PRACTICALS

1. To find flash point and fire point of a given fuel.
2. To find viscosity of given fuel.
3. To conduct Morse test on multi cylinder petrol engine

4. To prepare heat balance sheet of an IC engine
5. Identification of components in air conditioning system.
6. To find out specific fuel consumption of engine by gravimetric or volumetric apparatus
7. To find viscosity index of lubricant by Orsat apparatus
8. Study of components of a refrigerator
9. Study of components of an air-conditioner

INSTRUCTIONAL STRATEGY

Teachers should provide simple exercises to students involving applications of various concepts and principles being covered in the subject. Tutorial sheets on various topics should be prepared and students should be asked to solve them. In practical work, students should independently perform practicals.

LIST OF BOOKS

1. Thermal Engineering by SK Kulshreshtha; Vikas Publishing House Pvt. Ltd., Delhi
2. Thermal Engineering by A.S. Sarao; Satya Prakashan, New Delhi
3. Engineering Thermodynamics by Valan A. Arasu, TMH, Delhi
4. Thermal Engineering by P.L. Ballaney; Khanna Publishers, Delhi
5. Thermal Engineering by R.K. Rajput; Laxmi Publications, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	4	8
2	4	8
3	6	12
4	6	12
5	5	10
6	6	14
7	6	14
8	5	12
9	6	10
Total	48	100

3.3 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

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RATIONALE

The objective of the course is to impart basic knowledge and skills regarding electrical engineering, which diploma holders will come across in their professional life

DETAILED CONTENTS

1. Application and Advantage of Electricity (4 hrs)
Difference between AC and DC, various applications of electricity, advantages of electrical engineering over other types of energy
2. Basic Quantities of Electricity (4 hrs)
Definition of voltages, current, power and energy with their units, name of instruments used for measuring above quantities, connection of these instruments in an electric circuit
3. Electromagnetic Induction (4 hrs)
Production of e.m.f., idea of a transformer and its working principle
4. Distribution System (8 hrs)
Difference between high and low voltage distribution system, identification of three-phase wire, neutral wires and earth wire in a low voltage distribution system. Identification of voltages between phases and between one phase and neutral. Difference between three-phase and single-phase supply
5. Domestic Installation (7 hrs)
Distinction between light and fan circuits and single phase power circuit, sub-circuits, various accessories and parts of electrical installation. Identification of wiring systems. Common safety measures and earthing
6. Electric Motor (9 hrs)
Definition and various applications of single-phase and three-phase motors. Connection and starting of three-phase induction motors by star-delta starter. Changing direction of rotation of a given 3 phase induction motor

7. Electrical Safety (5 hrs)
Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs
8. Basic Electronics (7 hrs)
Basic idea of semiconductors – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, their characteristics and uses, characteristics and application of a thyristor, characteristics and applications of servo motors.

LIST OF PRACTICALS

1. Connection of a three-phase motor and starter with fuses and reversing of direction of rotation
2. Connection of a single-phase induction motor with supply and reversing of its direction of rotation
3. Charging of a lead – acid battery
4. Troubleshooting in domestic wiring system
5. Connection and reading of an electric energy meter
6. Study of a distribution board for domestic installation
7. Use of ammeter, voltmeter, wattmeter, energy meter and multi-meter
8. Ohm's Law verification
9. Verification of law of resistance in series
10. Verification of law of resistance in parallel
11. Study of different types of fuses
12. Study of earthing practices

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi

3.4 WORKSHOP TECHNOLOGY - I

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RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes, modern machining methods, processing of plastic, CNC machining, tool, jigs and fixtures is required to be imparted. Hence the subject of workshop technology.

DETAILED CONTENTS

1. Welding Process (2 hrs)
 - Principle of welding
 - Welding positions and techniques, symbols.
2. Gas Welding (3 hrs)
 - Types of gas welding flames and their applications
 - Gas welding equipments- Gas welding torch, Oxy – acetylene cutting torch, Blowpipe, Pressure regulators, Filler rods and fluxes.
3. Arc Welding (3 hrs)
 - Arc welding machines and equipment
 - A.C. and D.C. arc welding
 - Effect of polarity, current regulation and voltage regulation
 - Electrodes: Classification, B.I.S. specification and selection
 - Flux for arc welding
4. Other Welding Processes (3 hrs)
 - Principle of resistance welding, working and applications of spot welding, seam welding, projection welding and percussion welding.
 - Welding defects and inspection of welded joints.
5. Modern Welding Methods (4 hrs)

Principle of operation, advantages, disadvantages and applications of:

 - Tungsten inert gas (TIG) welding
 - Metal inert gas (MIG) welding
 - Thermit welding
 - Electro slag welding

6. Pattern Making (3 hrs)
- Types of pattern
 - Pattern material
 - Pattern allowances
 - Pattern codes as per B.I.S.
 - Introduction to cores, core boxes and core materials
 - Core making procedure
 - Core prints, positioning of cores
7. Moulding Sand (2 hrs)
- Properties of moulding sand, their impact and control of properties viz. permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility.
 - Various types of moulding sand.
8. Mould Making (3 hrs)]
- Introduction to moulding tools
 - Types of moulds
 - Step involved in making a mould
 - Moulding boxes, hand tools used for mould making
 - Moulding processes: Bench moulding, floor moulding, pit moulding and machine moulding.
9. Special Casting Processes (2 hrs)
- Principles, working and applications of
- Dies casting: hot chamber and cold chamber
 - Centrifugal casting
10. Gating and Riser System (2 hrs)
- Elements of gating system
 - Pouring basin, sprue, runner, gates
 - Types of risers, location of risers
 - Directional solidification
11. Casting Defects (3 hrs)
- Different types of casting defects
 - Testing of defects: radiography, magnetic particle inspection, and ultrasonic inspection.

12. Lathe (8 hrs)
- Description and function of various parts of a lathe
 - Classification and specification of various types of lathe
 - Work holding devices
 - Lathe operations: - Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling.
 - Cutting parameters – Speed, feed and depth of cut for various materials and for various operations, machining time.
 - Lathe accessories:- Centers, dogs, chucks, collets, face plate, angle plate, mandrel, steady rest, taper turning attachment, tool post grinder
13. Drilling (4 hrs)
- Classification of drilling machines and their description.
 - Various operations performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
 - Speeds and feed during drilling, impacts of these parameters on drilling, machining time.
 - Types of drills and their features, nomenclature of a drill
 - Drill holding devices.
 - Types of reamers.
14. Boring (3 hrs)
- Principle of boring
 - Classification of boring machines and their brief description.
 - Specification of boring machines.
 - Boring tools, boring bars and boring heads.
 - Description of jig boring machine.
15. Cutting Tools and Cutting Materials (3 hrs)
- Various types of single point cutting tools and their uses.
 - Single point cutting tool geometry, tool signature.
 - Properties of cutting tool material.
 - Study of various cutting tool materials viz. High speed steel, tungsten carbide, cobalt steel, cemented carbides, satellite, ceramics and diamond.
 - Cutting fluid – their types, importance, properties & advantages and applications.

REFERENCE BOOKS

1. A Text Book of Welding Technology by O.P. Khanna.
2. Welding Technology by R.L. Agarwal and Tahil Maghanani; Khanna Publishers, Delhi.
3. A Text Book on Foundry Technology by M.Lal and O.P.Khanna.
4. Foundry Engineering by Tahil Maghnani.
5. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons, Delhi.
6. Workshop Technology by RC Jindal; Ishan Publication Ambala City.
7. Elements of Workshop Technology by S.K.Choudhary and Hazara; Asia Publishing House.

RATIONALE

Diploma Holders are required to read and interpret drawings. Therefore it is essential that they have competency in preparing drawings and sketches of various machine parts. Therefore this subject is essentially required.

DETAILED CONTENT

1. Introduction

- Limits and Fits: Limit system – tolerance, limits, deviation, allowance, basic size, design size. Tolerances-fundamental tolerances, fundamental deviation, method of placing limit dimensions.

Fits: Clearance fit, transition fit, interference fit, hole basis system, shaft basis system, tolerance grades.

Calculating values of clearance/interference, hole tolerance and, shaft tolerance with given basic size for common assemblies like H7/g6, H7/m6, H8/u7.

- Surface Roughness

Introduction-actual profile, reference profile, datum profile, mean profile, peak-to-valley height, mean roughness index, surface roughness number.

Use of machining symbols in production drawings, indication of surface roughness-indication of special surface roughness characteristics, indication of machining allowance, indication of surface roughness, symbols on drawings, method of indicating surface roughness on given components.

Indicating roughness on a component for: -

- i) Surface to be obtained by any production method.
- ii) Surface to be obtained without removal of material.

2. Shaft Couplings

(2 sheets)

- Oldham coupling
- Universal coupling

3. Bearings (5 sheets)
- Bush bearing
 - Foot step bearing
 - Plummer block
 - Self aligning bearing
 - Brackets
4. Pipe Joints (5 sheets)
- Symbols for piping and layout plan of piping
 - Flanged joint
 - Socket and spigot joint
 - Union joint
 - Expansion pipe joint
5. I.C. engine parts (2 sheets)
- I.C. engine connecting rods
 - I.C. engine pistons
6. Screw Jack (1 sheet)

RECOMMENDED BOOKS

1. Machine Drawing by P.S. Gill; S.K. Kataria and Sons, Delhi.
2. Machine Drawing by R.K. Dhawan; S. Chand and Company, Delhi.
3. Machine Drawing by R.B. Gupta; Satya Parkashan, New Delhi.
4. Machine Drawing by N.D. Bhatt; Charotar Publishing House.

- Note:**
1. The drawings should include dimensions with tolerances, wherever necessary, and material list according to B.I.S. specifications as per SP46: 1988.
 2. 25% of the drawing sheets should be drawn using AutoCAD.

3.6 WORKSHOP PRACTICE I

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RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, skills in various machining processes, modern machining methods, processing of plastic, CNC machining, tool, jigs and fixtures is required to be imparted. Hence the subject of workshop practice.

LIST OF PRACTICALS

WELDING

1. Making following types of joints by gas welding
 - Preliminary joining practice
 - Vertical welding
2. Exercises of gas welding on the following
 - Aluminum
 - Brass
 - Copper
 - C.I.
3. Gas cutting of the following types
 - Preliminary gas cutting practice
 - Stock cutting by oxy acetylene
 - C.I. cutting
4. Making following types of joints by arc welding on M.S, C.I and aluminium
 - Joining practice by arc welding
 - Butt and lap joint (in vertical position, travel up and down).
 - Welding of outside corner joint.
 - Inspection of the welding defects occurred in the job.
5. Exercise on spot welding.
6. Exercise on projection welding (industrial visit should be arranged).
7. Exercise on brazing.

8. Exercise on TIG welding.
9. Exercise on MIG welding.

FOUNDRY

10. Preparation of the following types of moulds.
 - Floor molding
11. Moulding and casting of
 - A solid pattern
 - A split pattern
12. Testing and inspection of casting defects visually.
13. Study of constructional features of coupla furnace.

TURNING

14. Simple exercise on turning and step turning.
15. A composite job involving turning, taper turning, thread cutting and knurling and Eccentric turning.
16. Exercise on internal threading on lathe.

DRILLING AND FITTING

17. Marking and drilling practice using column and knee type drilling machine and radial drilling machine.
18. A job on drilling, threading, reaming, counter boring and counter sinking.
19. Exercise on boring with the help of boring bar.
20. Dovetail fitting in mild steel piece
21. Radius fitting in mild steel piece.
22. Exercise on pipe bending on MS pipe and PVC pipe using pipe bending machine.

PATTERN MAKING

23. Preparation of solid pattern (single piece)
24. Preparation of split pattern
25. Preparation of self cored pattern

- Note:**
1. The Workshop Superintendent will prepare & finalize the specific drawings of all jobs in the beginning of semester in consultation with staff
 2. The Institutions where foundry shop is not existing, they should arrange a visit to foundry industry in the nearby area.