

# 4.1 Strength of Materials

L T P  
4 - 2

## RATIONALE

Diploma holders in this course are required to analyse 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.

## DETAILED CONTENTS

### 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 moment.
- 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), determination 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
- 10.5 Efficiency of riveted joints

## 11. Columns and struts

06 Period

- 11.1 Definition, Types of column
- 11.2 Buckling load, crushing load
- 11.3 Slenderness ratio.
- 11.4 Factors affecting strength of column
- 11.5 Euler's formula for long columns
- 11.6 End restraints, effective length for different end conditions
- 11.7 Rankine Gourdan formula
- 11.8 Direct and eccentric loading with stress diagram
- 11.9 Direct and bending stresses and their combination

### LIST OF PRACTICALS

- 1. Perform tensile test on bars of mild steel and aluminum.
- 2. Perform shear test on specimen of two different metals.
- 3. Carry out bending tests on a steel bar or wooden beam.
- 4. Perform following impact test:
  - (a) Izod impact test
  - (b) Charpy test
- 5. Perform torsion test on specimen of different metals for determination of angle of twist for a given torque.
- 6. Determine the stiffness of a helical spring and to plot a graph between load and extension.
- 7. Perform hardness test on metal and finding the Brinell hardness, Rockwell hardness and Vicker's hardness.

### INSTRUCTIONAL STRATEGY

- 1 Use computer based learning aids for effective teaching-learning
- 2 Expose the students to real life problems.
- 3 Plan assignments so as to promote problem solving abilities and develop continued learning skills.

### 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.
- 3. Mechanics of Materials by Kirpal Singh; Standard Publishers, New Delhi.
- 4. Elements of Strength of Materials by D.R. Malhotra and H.C, Gupta; Satya Parkashan, New Delhi.
- 5. Mechanics of Solids by VS Prasad; Galgotia Publications, New Delhi.
- 6. Strength of materials Dr. B.C Puniya & S.Rama Murthi; Laxmi Publication, New Delhi.
- 7. Mechanics of solids by J.K.Kapoor; Bharat Bharati Prakashan, Meerut

## SUGGESTED DISTRIBUTION OF MARKS

| <b>Topic No.</b> | <b>Time Allotted (Period)</b> | <b>Marks Allotted (%)</b> |
|------------------|-------------------------------|---------------------------|
| 1.               | 03                            | 05                        |
| 2.               | 08                            | 10                        |
| 3.               | 06                            | 10                        |
| 4.               | 06                            | 10                        |
| 5.               | 06                            | 10                        |
| 6.               | 06                            | 10                        |
| 7.               | 05                            | 10                        |
| 8.               | 05                            | 05                        |
| 9.               | 07                            | 10                        |
| 10.              | 06                            | 10                        |
| 11               | 06                            | 10                        |
| <b>Total</b>     | <b>64</b>                     | <b>100</b>                |

## 4.2 MEASUREMENT, INSTRUMENTATION AND CONTROL

L T P  
Periods/week 5 - 2

### RATIONALE

A diploma holder should have knowledge of measurement systems, various sensors, transducers and devices for measuring various parameters. Hence this subject.

### DETAILED CONTENTS

1. Measurements and Measurement Systems (06 period)  
Definition, significance of measurement, generalized measurement systems, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, sources of errors in measurement, classification of errors
2. Sensors, Transducers and Strain Gauges (12 period)  
Introduction, classification, primary sensing elements, photo sensors, hall effect sensors, transducer conditioning, transducer selection and specification, resistance transducers, variable inductance type transducers, capacitive transducers, piezoelectric transducers, introduction to strain gauges, gauge materials,
3. Measurement of Force, Torque, Shaft Power, Speed and Acceleration (10 period)  
Introduction, force and weight measurement systems, measurement of torque, shaft power, speed and velocity, acceleration, pressure measurements
4. Temperature and Strain Measurement (10 period)  
Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer, strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor
5. Comparators and Angular Measurement (12 period)  
Introduction to comparators, characteristics, classification of comparators, mechanical comparator, electric and electronic comparators- principles. LVDT, pneumatic comparators, angular measurements, bevel protractor
6. Determination of Count and Measurement of Time, Time Interval and Frequency (10 period)  
Introduction, counters, time and frequency standards, clock and watches, frequency interval and frequency
7. Signal Transmission and Processing (10 period)  
Introduction, interfacing circuits, amplifiers, modulation and demodulation, filters, transmission of signal and data, devices and systems, signal display & recording devices
8. Measurement of Process Variables -Pressure, Temperature, Flow and Level (04 period)  
Introduction, pressure, temperature, flow rate, level measurement, thermometers, bimetallic thermocouples, thermistors and pyrometers.

9. Automation and Control (06 period)  
 Definition, types, need of automation, advantages and disadvantages of automation, introduction of control system terminology introduction to numerical control, basic concepts of NC, CNC and DNC. PLC and its applications in automotive industry

### INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for teaching learning
2. Demonstrations should be made to explain the concepts

### RECOMMENDED BOOKS

1. Mechanical Measurements by Beckwith Marangoni and Lienhard; Pearson Education, 6th Ed., 2006
2. Engineering Metrology by R.K. Jain; Khanna Publishers, 1994
3. Industrial Instrumentation by Alstutko and Jerry. D. Faulk; Thompson Asia Pvt. Ltd.2002
4. Mechanical Measurements by Beckwith Thomas G; Narosa Publishing House, N. Delhi
6. Measurement Systems, Application Design by Doeblein E.O; McGraw Hill, 1990
6. Mechanical Measurements and Control by Kumar D.S ; Metropolitan, N. Delhi
7. Mechanical Measurement by Sirohi; New Age Publishers
8. Instrumentation and Control by D, Patranabis; ISBN No. 81-88114-30-8, Umesh Publications

### SUGGESTED DISTRIBUTION OF MARKS

| Topic No.    | Time allotted (Period) | Marks Allotted (%) |
|--------------|------------------------|--------------------|
| 1            | 06                     | 08                 |
| 2            | 12                     | 16                 |
| 3            | 10                     | 12                 |
| 4            | 10                     | 12                 |
| 5            | 12                     | 14                 |
| 6            | 10                     | 12                 |
| 7            | 10                     | 12                 |
| 8            | 04                     | 06                 |
| 9            | 06                     | 08                 |
| <b>Total</b> | <b>80</b>              | <b>100</b>         |

## 4.3 AUTOMOTIVE ENGINE

L T P  
5 – 2

### RATIONALE

A diploma holder in this field must have knowledge of combustion phenomenon, fuel system and ignition system in engine. In addition, knowledge about engine testing and engine pollutant is also necessary. Hence this subject

### DETAILED CONTENTS

#### 1. INTRODUCTION TO IC ENGINE

12 Period

##### 1.1 Layout and working of an internal combustion engine,

- Engine terms – bore, stroke, dead center, compression ratio, swept volume, clearance volume, capacity, torque, power and the crank shaft.
- Classification and brief description of engine as per stroke, cycle, fuel, ignition, cooling and number and arrangement of cylinders, valve arrangement.
- HCCI Engine
- Alternate Fuel Engine
  - LPG/CNG Vehicle
  - Electric Vehicles
  - Hybrid Vehicles
  - Plug in hybrid Vehicles
  - Wheel motor Vehicles
  - Fuel cell Vehicles

##### 1.2 Constructional Details

- Constructional details of cylinder block, cylinder head, cylinder liner, piston, piston coatings, piston rings, gudgeon pin, connecting rod, crankshaft, camshaft, valve timing, valve mechanism, camless engines, flywheel and damper.

#### 2. COMBUSTION

12 Period

- Phenomenon of combustion in CI engines and SI engines  
Methods producing turbulence. Various types of combustion chamber for petrol and diesel engines. Detonation, preignition and knocking, octane and cetane numbers, swirl and squish

### **3. FUELS and FUEL SYSTEM**

**10 Period**

#### **3.1 FUELS**

- Properties of engine fuels, types of auto engine fuels. Properties of conventional fuels (petrol and diesel)

#### **3.2 FUEL SYSTEM**

- *Fuel system in spark ignition engine*; Fuel feed system, fuel pumps, their types, construction and working, concept of carburetion. Working and construction of simple carburetor. Advantages of using fuel injection system in spark ignition engines. Concept of MPFI system, constructional details of an MPFI system. Dry and wet air cleaners, direct injection in petrol engines.
- *Fuel system in compression ignition engine*; Fuel filter – primary and secondary, Fuel injection pumps- plunger and barrel type, distributor type; priming of fuel feed pumps, Fuel injectors and solid injection, Common rail direct injection (CRDI). Layout and details of a CRDI fuel supply system. Type of nozzles, Governing and types of governors. Use of turbo charger and super charger in diesel engine

### **4. IGNITION SYSTEM in SI ENGINE**

**08 Period**

- Concept of ignition system, battery ignition system. Function and constructional details of ignition coil, condenser, contact breaker point, distributor, spark plugs. Ignition timing systems. Distribution less ignition system, Capacitor discharge system, Coil on plug system

### **5. COOLING SYSTEM**

**08 Period**

- Necessity of cooling system. Air cooling, water cooling system. Components of water cooling system – Radiators, thermostat, water pump fan, pressure cap, water jackets, antifreeze solution. Trouble shooting

### **6. LUBRICATION SYSTEM**

**10 Period**



- Necessity of lubrication, types of lubricants, lubricant rating, oil additives, effect of engine conditions on consumption of lubricant oil, crank case ventilation, pressure lubrication system, splash lubrication. Components of lubrication system – oil pump, oil lines, oil filters, oil coolers, classification and service ratings of lubricating oil, additives for lubricants.

## **7. ENGINE TESTING& PERFORMANCE**

**10 Period**

### *7.1 Engine Testing*

- Classification of tests, fault finding test, routine test, measurement of IP, BP, mechanical efficiency, thermal efficiency, fuel consumption, relative efficiency, air consumption, volumetric efficiency, lubricating oil consumption. Heat balance sheet

### *7.2 Performance of Engine*

- Performance curves, Effect on engine performance due to atmospheric temperature, pressure, compression ratio, engine speed, RAC/SAE/DIN engine ratings

## **8. ENGINE POLLUTANTS & ITS CONTROL**

**10 Period**

- Sources of engine pollutants of SI and CI engine. Effect of pollutants on human beings and environment
- Methods of Control – Crank case ventilation, fuel tank ventilation, carburetion and recirculation. V.V.T, Exhaust gas recirculation systems. Catalytic converters. Close loop feedback selective catalytic reaction. Exhaust gas treatment for diesel engines. Emission Norms (Latest Bharat/Euro norms) III & IV.

## **LIST OF PRACTICALS**

1. Dismantling, inspection and assembling of fuel injection pump.
2. Gasoline engine Emission test using exhaust gas analyser.
3. Diesel engine Emission test using smokemeter.
4. Servicing of valves valve mechanism.
5. To conduct Morse test on multi cylinder petrol engine.
6. Servicing of lubricating system.
7. Servicing of fuel systems in petrol engines.

8. Servicing of fuel injector.
9. Engine tune up
10. Study of turbocharger.
11. Servicing of cooling system.
12. Study of MPFI system.

## RECOMMENDED BOOKS

1. Automobile Engineering by P.S. GILL
2. Automobile Engineering Vol. 2 by Dr. KIRPAL SINGH; Standard Publishers Distributors, 12<sup>th</sup> or later edition
3. Automobile Engineering by R.B. GUPTA; Satya Prakashan, New Delhi.
4. Automobile Engineering by KM GUPTA, Umesh Prakashan, Delhi.

## SUGGESTED DISTRIBUTION OF MARKS

| TOPIC NO. | TIME ALLOTTED (Hrs.) | MARKS ALLOTTED (%) |
|-----------|----------------------|--------------------|
| 1         | 12                   | 20                 |
| 2         | 12                   | 20                 |
| 3         | 10                   | 10                 |
| 4         | 08                   | 10                 |
| 5         | 08                   | 10                 |
| 6         | 10                   | 10                 |
| 7         | 10                   | 10                 |
| 8         | 10                   | 10                 |
| TOTAL     | 80                   | 100                |

## 4.4 SUSPENSION, STEERING & BRAKING

L T P  
Periods/week 5 - 2

### RATIONALE

Suspension, steering and braking forms the important components of automobile engineering. The subject aims at imparting knowledge and skills regarding suspension, steering and braking system of vehicles.

### DETAILED CONTENTS

#### 1. Suspension System (12 periods)

Function, types- independent, rigid axle. Springs – functions, construction materials and types (coil spring, leaf spring and torsion bar) sprung and unsprung weight, characteristics of springs, spring eye, bushes, variable rate spring, helper leaves, leaf sections, camber grading and nipling spring seats, rubber pads, pressure blocks, spring cover, interleaf inserters. Function and construction of hydraulic dampers (shock absorbers). Pneumatic suspension system – lay out and working. Function and Construction of hydraulic damper (shock absorber). Diagnosis of common faults and their rectifications

#### 2. Front Axle (03 periods)

Types – Stub double drop, fully dropped, load distribution, effect of braking on axle shape, steering head, Elliot and reverse Elliot, steering knuckle

#### 3. Steering (14 periods)

- Power steering - necessity, types, Construction features and working of hydraulic and electronic power steering system, Four wheel steering, Common steering system troubles and remedies
- Steering mechanism, function, Davis and Ackerman's Principle of steering. Working and constructional details of steering gear, steering linkages, sector arm, center arm, drag link and tie rod steering stops. Front wheel geometry-caster, camber, steering axis inclination, toe in and toe out. Cornering force, cornering power and self-righting torque. Over steering and under steering. Common steering troubles and remedies

#### 4. Wheel and Tyres (09 periods)

Wheels – types, hub attachment, wheel specification, Tyres - classification and types. Construction of pneumatic tyres, composition of covers, tread breaker, bead and casing, comparison of cross-ply and radial-ply tyres. Causes of excessive tyre wear. Tyre care and maintenance. Static and dynamic balance. Tubeless tyres, Run flat tyres, retreading of tyers

## 5. Braking System

(10 periods)

- Purpose of brakes, layout of braking system, components, Types of brakes- mechanical, hydraulic, power. Principle of hydraulic brakes, braking action, master cylinder, wheel cylinder, leading and trailing shoes, self adjusting brakes, self applying and self releasing action, anti-skid devices, pedal travel, brake enclosures, Drum brakes- Construction & Working, Disc. Brakes- Construction and Working. Common faults and their rectification.
- Power Brakes - Air, air-hydraulic, hydro-vac brakes-their construction components and working details. Brake fluid and its characteristics, brake liner, hand brake, Antilock brake systems. Brake test, common faults and their rectification.

### LIST OF PRACTICALS

1. Study and sketch of suspension system - coil spring, leaf spring, torsion bar, shock absorber
2. Study and sketch of power brake system
3. Study and sketch of epicyclic gear box
4. Study and sketch of torque converter
5. Study and sketches of mechanical and hydraulic brake system and its parts

### INSTRUCTIONAL STRATEGY

Teacher should make use of audio visual aids to show features of chassis, body and transmission. Demonstration should be made in the automobile shop to explain various aspects of chassis, body and transmission.

### RECOMMENDED BOOKS

1. Automobile Engineering, Vol. I by Dr. Kirpal Singh, Standard Publishers, Delhi
2. Automobile Engineering by GBS Narang, Khanna Publishers, Delhi
3. Automobile Engineer (in Hindi) by Dr. Kirpal Singh, Standard Publisher, Delhi
4. Chassis, Body and Transmission by Vijay Singh & Raj Kumar, Ishan Publications, Jalandhar

### SUGGESTED DISTRIBUTION OF MARKS

| Topic No.    | Time allotted (Periods) | Marks Allotted (%) |
|--------------|-------------------------|--------------------|
| 1            | 20                      | 24                 |
| 2            | 06                      | 08                 |
| 3            | 22                      | 28                 |
| 4            | 16                      | 20                 |
| 5            | 16                      | 20                 |
| <b>Total</b> | <b>80</b>               | <b>100</b>         |

## 4.5 AUTO ELECTRICAL AND ELECTRONICS EQUIPMENT

L T P

Periods/week 5 - 2

### RATIONALE

Diploma holders in Automobile Engineering have to deal with different types of batteries, their charging and testing, regulators, ignition system, lighting system and various other electrical accessories used in Automobile Engineering. Hence the subject of automotive electric equipment is very essential for these technicians.

### DETAILED CONTENTS

1. Introduction (04 periods)  
Various Electrical components/systems in Automobile. Their functions and demands, earth return system, types of earthing, 6V, 12V system
2. Batteries (16 periods)
  - 2.1 Lead Acid Batteries - Construction, working, elements, types, materials used, electrolyte and its strength, effect of added plate area and temperature, rating, capacity, efficiency, temperature characteristics, terminal voltages, charging and discharging
  - 2.2 Battery Testing: Electrolyte testing by hydrometer, voltage test, high discharge and cadmium test (voltage)
  - 2.3 Battery Charging: Constant potential and constant current, initial charging, normal charging, trickle charging, intermittent charging, boost charging.
  - 2.4 Battery Defects: Stipulation, plates decay, working, erosion, cracking, sedimentation, separator defects, short circuits, overcharging
  - 2.5 Alkaline Batteries: Construction, working, merits and demerits of Ni-Fe, Ni-Cd, Ag-Zn cells
  - 2.6 Lithium ion battery - Construction and working
3. Charging System (10 periods)
  - 3.1 Circuits, function and various components, dynamo and alternator, types, construction, working, advantages and disadvantages of dynamo and alternators, drives, cut out relay
  - 3.2 Regulation: Functions of various components of two unit, three unit and heavy duty Regulators, Regulator adjustments, Regulators for alternators
4. Starting System (14 periods)  
Function of various components, torque terms, principle and constructional details of starter motor, switches, types, starter to engine drive and their types, Starter-alternators
5. Ignition System (10 periods)
  - 5.1 Constructional details of coil, distribution, condenser, meaning of cam angle, ignition timing, ignition advancing mechanisms, centrifugal and vacuum type,

- transistorized ignition system, construction and working details of magneto ignition system
- 5.2 Spark Plugs: Constructional details of spark plugs, classification as per reach, heat range, diameter, and effect of leaded fuels, care and maintenance of spark plug
6. Lighting System (08 periods)
- 6.1 Various lighting circuits, head lamp, type and constructional details, sealed beam, double filaments, asymmetric and dual units, vertical and side control of lamps, fog light, side light, brake light, instrument light, indicator lights, reversing light, lamp mounting
- 6.2 Wiring: HT and LT, their specifications, cable colour codes, wiring Harness, Cable connections, Wiring diagrams of cars and two wheeler, Fuses, faults and rectification
7. Electrical Accessories (07 periods)
- Fuel gauges- bimetallic and balancing coil type, Air pressure gauges, temperature gauges, Ammeter, warning light, speedometer, wind screen wipers, horns, horn relay, electric fuel pump, Faults and rectification
8. Miscellaneous Electrical Equipment (03 periods)
- Impulse Speedometer, tachometer, heaters, defrosters, Air conditioner, and Electric door locks, window actuation, Seat adjusters, Electric motors and Pumps – Definition, types and various application of single phase and three phase motors, type of pumps and their applications, direct online starter and star delta starter
9. Electronic Devices (02 periods)
- Automobile electronic devices, Sensoring units, Computer controlled sensors
10. Electronics and Computer Applications in Automobiles (06 periods)
- Introduction to circuit-symbols, Integrated circuits, Amplifiers, filters stepper and synchronous motors, Logic gates, Combinational and sequential logics, Flip flops, sensors. Analog and digital devices, converters, signal conditioners, communication chips, multiplexed wiring, working of ECU, microprocessor and its applications, concept of operation by wire

## LIST OF PRACTICALS

1. Testing of Battery with hydrometer and high rate discharge tester, charging of Batteries.
2. Testing and measurement of ignition timing and dwell angle with timing light and cam angle tester.
3. Testing, cleaning and setting of spark plug on spark plug cleaning and testing machine.
4. Testing of alternator rotor and stator winding for short circuit, ground and broken circuit.
5. Head light beam setting.
6. Testing and setting of horn and relay.
7. Testing and fault tracing of field winding, armature and magnetic switch for short circuit, grounding of a starter.

8. Testing dipper switch, flasher unit and indicator circuits and fault tracing.
9. Testing and fault tracing of different components of transistorized ignition system.
10. Testing of magneto ignition circuit and Adjustment.
11. Identification of colour codes for continuity test in a wiring harness.
12. Study and sketching of complete wiring circuit of an Indian vehicle.
13. Dismantling, inspection and assembling of alternator.
14. Dismantling, inspection and assembling of starter motor.
15. Identify various electrical components on the mock up wiring board.
16. Removing and refitting head light assembly, head light beam setting.
17. Checking and setting of horn, relay, dipper switch, flasher unit and indicator circuits.

### **INSTRUCTIONAL STATREGY**

Teachers should lay emphasis on concepts and principles while imparting instructions. As far possible, subject teaching should be supplemented by demonstrations in the laboratory. During practical work, individual students should be given opportunities to perform practicals independently.

### **RECOMMENDED BOOKS**

1. Automobile Engineering by Kirpal Singh, Standard Publishers, Delhi
2. Automotive Electrical Equipment by P.L. Kohli, Tata McGraw Hill, Delhi
3. Automotive Electrical Equipment by William H. Crouse, Tata McGraw Hill, Delhi
4. Automobile Engineering by R.B. Gupta, Satya Prakashan, New Delhi

### **SUGGESTED DISTRIBUTION OF MARKS**

| <b>Topic No.</b> | <b>Time Allotted<br/>(Periods)</b> | <b>Marks Allotted (%)</b> |
|------------------|------------------------------------|---------------------------|
| 1                | 04                                 | 05                        |
| 2                | 16                                 | 20                        |
| 3                | 10                                 | 12                        |
| 4                | 14                                 | 16                        |
| 5                | 10                                 | 12                        |
| 6                | 08                                 | 10                        |
| 7                | 07                                 | 09                        |
| 8                | 03                                 | 05                        |
| 9                | 02                                 | 02                        |
| 10               | 06                                 | 09                        |
| <b>Total</b>     | <b>80</b>                          | <b>100</b>                |

## 4.6 MANUFACTURING TECHNOLOGY

L T P  
Periods/week 5 - 6

### RATIONALE

The knowledge of manufacturing techniques in the area of foundry, machine shop (fitting shop, lathe machines and shaping), inspection and gauging and in coating both on metallic and non-metallic is essential at the first stage for understanding technology. Hence this subject.

### DETAILED CONTENTS

1. Fitting (15 periods)  
Fits, limits and tolerances and their applications, unilateral and bilateral tolerances, gauges, gauge tolerances, use of micrometer, vernier, height gauges, dial comparator, straight edge, surface plate. Metal cutting, metal shear, metal sawing, metal bending processes
2. Metallic and Non-metallic Coatings (15 periods)  
Necessity of metallic and non-metallic coatings, principles and processes of electroplating, galvanizing, metal spraying, painting and their applications, preparation of base materials. Uses of primers, paints and finish coatings, powder coating and its advantages
3. Foundry (15 periods)  
Introduction, types of patterns, pattern materials, cores and core boxes, core materials, preservation and storage of patterns,. Introduction to moulding, types of moulding, types of moulds, preparation of cores, defects in moulds and their remedies, casting defects and their remedies
4. Lathe (15 periods)
  - Introduction, types of lathes, specifications, description and functions of lathe parts, feed mechanism, drives and transmission, work holding devices, turning tools
  - Lathe operations – plain turning, facing, centring, parting off, undercutting, taper turning, eccentric turning, drilling, reaming, thread cutting and knurling. Speed, feed and depth of cut
  - Introduction to capstan and turret lathes, copying lathe and their attachments, difference between capstan and turret lathes and heads, tool holders and tool layout, tool geometry and use of throwaway tips, brazed tools and HSS tools
5. Shaper (05 periods)  
Operation and mechanism
6. Inspection Instruments and Gauges (15 periods)  
Height gauge, depth gauge, bore gauge, slip gauge, sine bar, measurement of taper by use of slip gauges, interchangeability, Go and Not-Go gauges, screw thread micrometer,



thread gauge, radius gauge, dial gauge, and gear tooth vernier, hardness checking instruments, coating thickness checking instruments, surface finish checking instruments. Quality Control, concept of control chart.

## **LIST OF PRACTICALS**

### **1. Fitting shop**

Bench work and fittings; simple male-female fitting (fitting of pulley, bearings, gears on shafts), scraping, pipe fittings with leak proof joints, checking alignment and centre distance

### **2. Pattern making and Foundry shop**

- To prepare pattern of rectangular block, 'V' block, step pulley with core box, split pattern
- Preparation of open floor mould of solid pattern, cope drag mould using split pattern
- Visit to foundry to see castings of cast iron, steel, non-ferrous materials, hand moulding, machine moulding and melting furnaces. Induction heating and gas fired furnace

### **3. Lathe**

- Introduction to turning machine and allied services like cutting tool grinding, general shop layout including maintenance, oils, tools and gauge stores.
- Different exercises in turning like plain turning, step-turning, facing, chamfering, knurling, parting off and thread cutting, use of compound slide and tailstock, tool grinding, selection of coolant and lubricants and speed and feeds. Use of safety goggles

## **INSTRUCTIONAL STRATEGY**

1. Teachers should lay emphasis on making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.
2. Focus should be laid in preparing jobs using various machines in the workshop.

## **RECOMMENDED BOOKS**

1. Workshop Technology by BS Raghuwanshi, Dhanpat Rai & Sons, Delhi
2. Elements of Workshop Technology by SK Choudhary & Hazara, Asia Publishing House
3. Principles of Foundry Technology by Jain, Tata McGrawHill, New Delhi
4. Workshop Technology, Vol-I, II & III by Chapman, Standard Publishers Distributors, New Delhi

### SUGGESTED DISTRIBUTION OF MARKS

| <b>Topic No.</b> | <b>Time Allotted<br/>(Periods)</b> | <b>Marks Allotted (%)</b> |
|------------------|------------------------------------|---------------------------|
| 1                | 15                                 | 18                        |
| 2                | 15                                 | 18                        |
| 3                | 15                                 | 18                        |
| 4                | 15                                 | 18                        |
| 5                | 05                                 | 10                        |
| 6                | 15                                 | 18                        |
| <b>Total</b>     | <b>80</b>                          | <b>100</b>                |

## 4.9 INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

Internal assessment and external assessment have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry, if any. The components of evaluation will include the following.

|                                      |     |
|--------------------------------------|-----|
| a) Punctuality and regularity        | 15% |
| b) Initiative in learning new things | 15% |
| c) Relationship with workers         | 15% |
| d) Industrial training report        | 55% |