4.1 MATERIALS AND METALLURGY

L T P
3 - 2

RATIONALE

Lot of developments have taken place in the field of materials. New materials are being developed and it has become possible to change the properties of materials to suit the requirements. Diploma holders in this course 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 non ferrous materials and various heat treatment processes. This subject aims at developing knowledge about the characteristics, testing and usage of various types of materials used in industries.

DETAILED CONTENTS

1. Introduction (07 hrs)

   Material, History of Material Origin, Scope of Material Science, Overview of different engineering materials and applications, Classification of materials, Thermal, Chemical, Electrical, Mechanical properties of various materials, Present and future needs of materials, Overview of Biomaterials and semi-conducting materials, Various issues of Material Usage-Economical, Environment and Social.

2. Crystallography (07 hrs)

   Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals, Number of atoms per unit Cell, Atomic Packing Factor.

   Deformation: Overview of deformation behaviour and its mechanisms, behaviour of material under load and stress-strain.

   Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep.

3. Metals And Alloys (14 hrs)

   Introduction: History and development of iron and steel, Different iron ores, Raw Materials in Production of Iron and Steel, Basic Process of iron-making and steel-making, Classification of iron and steel,

   Cast Iron: Different types of Cast Iron, manufacture and their usage.

   Steels: Steels and alloy steel, Classification of plain carbon steels, Availability, Properties and usage of different types of Plain Carbon Steels, Effect of various alloys on

properties of steel, Uses of alloy steels (high speed steel, stainless steel, spring steel, silicon steel)

Non Ferrous Materials: Properties and uses of Light Metals and their alloys, properties and uses of White Metals and their alloys.

4. Theory of Heat Treatment (08 hrs)

Purpose of heat treatment, Solid solutions and its types, Iron Carbon diagram, Formation and decomposition of Austenite, Martensitic Transformation – Simplified Transformation Cooling Curves various heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening, Types of heat treatment furnaces required for above operations (only basic idea)

5. Engineering Plastics (03 hrs)

Important sources of plastics, Classification-thermoplastic and thermo set and their uses, Various Trade names of engg. Plastics, Plastic Coatings.

6. Advanced Materials (03 hrs)

Composites-Classification, properties, applications
Ceramics-Classification, properties, applications
Heat insulating materials

7. Miscellaneous Materials (06 hrs)

Properties and uses of Asbestos, Glass wool, thermocole, cork, mica. Overview of tool and die materials, Materials for bearing metals, Spring materials, Materials for Nuclear Energy, Refractory materials.

LIST OF PRACTICALS

1. Classification of about 25 specimens of materials/machine parts into
   (i) Metals and non metals
   (ii) Metals and alloys
   (iii) Ferrous and non ferrous metals
   (iv) Ferrous and non ferrous alloys
2. Given a set of specimen of metals and alloys (copper, brass, aluminium, cast iron, HSS, Gun metal); identify and indicate the various properties possessed by them.
3. Study of heat treatment furnace.
4. Study of a metallurgical microscope and a specimen polishing machine.
5. To prepare specimens of following materials for microscopic examination and to Examine the microstructure of the specimens of following materials:
   i) Brass ii)Copper iii)Grey iv)Malleable v)Low carbon steel vi)High carbon steel vii) HSS
6. To anneal a given specimen and find out difference in hardness as a result of annealing.

7. To normalize a given specimen and to find out the difference in hardness as a result of normalizing.
8. To harden and temper a specimen and to find out the difference in hardness due to tempering.

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of engineering materials to the students. Students should be asked to collect samples of various materials available in the market. Visits to industry should be planned to demonstrate use of various types of materials or Heat Treatment Processes in the industry.

RECOMMENDED BOOKS

1. Text book of Material Science by R.K. Rajput; Katson Pubs, Ludhiana
2. Text book of Material Science by Varinder Kumar, Eagle Publisher, Jalandhar
3. Text book of Material Science by V.K. Manchanda; India Publishing House, Jalandhar.
4. Engg. Metallurgy by R.A. Higgens, Standard Publishers, New Delhi
5. Introduction to Material Science by A.R. Gupta, Satya Prakashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	07	15
2.	07	15
3.	14	30
4.	08	16
5.	03	06
6.	03	06
7.	06	12
Total	**48**	**100**

4.2 MECHANICS OF VEHICLES

L	T	P
4	-	-

RATIONALE

Various types of motions, power transmission, forces acting on moving vehicle, vehicle braking, balancing and vibration in rotating body are some of the concepts which are essential for diploma holders in Automobile Engineering. Hence the subject is introduced in the syllabus.

DETAILED CONTENTS

1. Simple Mechanism (10 hrs)

- Definition of link, kinematic pair, kinematic chain, Mechanism, inversions and machines.
- Simple examples of mechanism with:-
- Lower pairs, Four bar chain, Slider crank chain, Double slider crank chain, Higher pairs

2. Motion and Turning Moment (10 hrs)

- Displacement, velocity and acceleration of piston.
- Angular velocity and angular acceleration of connecting rod.
- Calculations of piston effort and crank effort at different angles.
- Fly wheel - its types, weight and moment of inertia.
- Fluctuation of energy for fly wheel.
- Turning moment diagrams with reference to internal combustion engines.
- Analysis of Hooke's Joint.

3. Power Transmission (08 hrs)

- Flat belt, V-belt and chain drives.
- Ratio of tension of two sides of the belt with and without centrifugal tension.
- Horse power transmitted and condition for maximum horse power transmitted.
- Velocity ratios transmitted by
- Belts
- Simple, compound and epicyclic gear box.

4. Vehicle in Motion (10 hrs)

- Air, grade, and rolling resistances.
- Tractive effort, traction, Inertia load, Draw bar pull and power required to proper a vehicle.
- Calculations of acceleration and tractive effort required in case of front wheel drive, rear wheel drive and four wheel drive.
- Centrifugal force and its effect on vehicle stability on banked and unbanked road.

5. Vehicle Control (08 hrs)

- Braking friction and limits of braking.
- Retardation and Braking force, calculations in case of front wheel, rear wheel and all wheel braking.
- Weight transfer during braking.
- Stopping distance and stopping time.
- Davis and Ackermann Steering Mechanism, Correct Steering angle.

6. Balancing (10 hrs)

- Concepts of static and dynamic balancing, working of static and dynamic machine.
- Balancing of rotating masses-single rotating mass by a single mass rotating in the same plane and by two masses rotating in different planes, balancing of several masses rotating in the same plane. Balancing of several masses rotating in different planes.

7. Vibration (08 hrs)

- Introduction, Types of vibrating motion, Types of free vibrations, Natural Frequency of Free longitudinal Vibrations, Natural frequency of free, Transverse vibrations.
- Causes of vibration in rotating bodies, damping of vibrations, Free damped vibrations (Vacuum Damping)

INSTRUCTIONAL STATREGY

1. Models should be shown.
2. Practical demonstrations should be organized.

RECOMMENDED BOOKS

1. Theory of Machines by R.S. Khurmi
2. Automobile Engineering Vol-I, II, Dr. Kirpal Singh, Standard Publishers and Distributor, New Delhi
3. Theory of Machines by D.R. Malhotra; Satya Parkashion
4. Theory of Machines by PL Balaney; Khanna Publishers, Delhi.
5. Mechanics of Vehicles by W. Steed; Kafe books Limited, London.

SUGGESTED DISTRIBUTION OF MARK

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	10	18
3	08	12
4	10	15
5	08	12
6	10	16
7	08	12
Total	**64**	**100**

4.3 AUTO ENGINE - I

L	T	P
4	-	4

RATIONALE

Engine forms the heart of an automobile. As the scope of auto engines is very wide, it has been divided into two subjects, Auto Engine –I and Auto Engine-II. This subject deals with engine terminology basic concept of 2 stroke and 4 stroke engine, classification of engines, constructional details of petrol engine, fuel system, cooling system, lubrication system and ignition system,.

DETAILED CONTENTS

1. Introduction (12 hrs)

- Engine as a power source
- Concept of internal combustion engine.
- Engine dimensions: Bore, stroke, dead centres, compression ratio, swept volume, clearance volume, engine capacity, engine torque engine power at the crank shaft.
- Classification of engines as per stroke, cycle, fuel, ignition, cooling number and arrangement of cylinders, reciprocating and rotary.
- Concept of 2 stroke and 4 stroke engines and their comparison.
- Working principles of petrol and diesel engines.

2 Constructional details ` (11 hrs)

Constructional details of cylinder block, cylinder head, cylinder liner piston, piston rings, gudgeon pin, connecting rod, crankshaft, camshaft, valve mechanisms, flywheel and damper.

3. Fuel System (10 hrs)

Fuel system in spark ignition engine: Fuel feed system, fuel pumps-its types, fuel tank, fuel lines, fuel filters, concept of carburetion. Working and construction of a 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, concept of VVT technology.

4. Ignition System in S.I. Engine (12 hrs)

Concept of ignition system, battery and magneto types of ignition systems. Function of ignition coil, condenser, contact breaker point, distributors, spark plugs. Distribution less ignition system. Electronic ignition system.

5 Cooling System (09 hrs)

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 hrs)

Necessity of lubrication system, 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.

LIST OF PRACTICALS

1. Servicing of lubricating system
2. Servicing of fuel systems in petrol engines
3. Servicing of fuel injector
4. Servicing of F.I.P (Fuel Injection Pump)
5. Engine tune up
6. Study of turbocharger
7. Servicing of cooling system
8. Study of engine block
9. Servicing of fuel system in diesel engine
10. Study of M.P.F.I engine

INSTRUCTIONAL STRATEGY

The teacher should lay emphasis on making the students conversant with the principles and practices related to various types of engines. Audio visual aids should be used to show engine features and working. Demonstrations should be made in automobile shop to explain various engine components.

RECOMMENDED BOOKS

1. Automobile Engineering – Vol. II by Dr. Kirpal Singh; Standard Publishers Distributors.
2. Automobile Engineering by R.B. Gupta; Satya Prakashan, New Delhi
3. Automotive Engines by Srinivasan, TMH, Delhi

4. Automobile Engineering by Chikara, Dhanpat Rai and Sons, New Delhi
5. Automobile Engineering by KM Gupta, Umesh Publishers, Delhi
6. Auto Engine –I by G.S. Aulakh, Eagle Prakashan, Jalandhar.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	15
2	11	15
3	10	20
4	12	20
5	09	14
6	10	16
Total	**64**	**100**

4.4 MANUFACTURING TECHNOLOGY - II

L	T	P
4	-	4

RATIONALE

Knowledge in various machining operations viz. drilling, boring, milling, planing and grinding processes, finishing operations, gear production, CNC machining, bending forming and welding processes is very essential for the diploma holders. Hence this subject.

DETAILED CONTENTS

1. Drilling and Boring (10 hrs)

   Introduction, Types of drills, types of drilling machines i.e. portable, bench type, pillar and radial, drilling speeds and feeds, drill chucks and other accessories (jigs etc.) used in drilling machines, reaming, introduction to boring, types of boring machines – horizontal and vertical, specifications, boring bar and boring heads

2. Machining Processes (16 hrs)

   - Milling – Types of milling machines and their operations, speeds and feeds, indexing (simple and compound), types of milling cutters
   - Planning machines and their operation
   - Grinding – cylindrical, centreless and surface grinding machines, types of grinding wheels, specifications, grades and their selection, balancing of grinding wheels and their storage

3. Finishing Operations (06 hrs)

   Lapping, honing, super finishing operations and their applications, types of abrasives used and their selection

4. Gear Production (04 hrs)

   Gear cutting and gear shaving machines, gear cutters and coolants

5. CNC Machines (06 hrs)

   Introduction to CNC control systems, advantages, productivity, accuracy and cost

6. Bending and Forming (06 hrs)

   Description of press brakes, bending dies, forming machines

7. Welding (14 hrs)

   - Introduction, types of welding (gas welding, arc welding, resistance welding), butt welding, flash, projection, seam and spot welding. Selection of electrodes, filter metals, types of welding defects and their remedies, soldering and brazing – processes and applications
   - Special welding processes for stainless steel and aluminium

8. Types of Coolants and Lubricants for various machining processes (02 hrs)

LIST OF PRACTICALS

1. Introduction to drilling and boring machines, an exercise of simple drilling and boring operation, selection of speeds and feeds, use of jigs and fixtures and coolant.
2. Simple exercises on shaper
3. Practice on horizontal and vertical milling machines, work holding devices and types of milling cutters
4. Practice on cylindrical and centreless grinding machine, selection, dressing and storage of grinding machines. Use of lubricants
5. Practice on honing machines with selection of honing sticks, honing and finish pattern in the bore. Bore geometry measurement
6. Observe working of CNC machines including setting of cutting parameters and dimensions and loading of tools, repeatability of operation and adjustment for wear allowances
7. Visit to industry (sheet metal shoos) to observe bending and forming operation and use of dies
8. Use of appropriate coolant and lubricants for all machining operation in the workshop and during Industrial visits.

RECOMMENDED BOOKS

1. Workshop Technology by BS Raghuvanshi, Dhanpat Rai & Sons, Delhi.
2. Workshop Technology Vol. – I, II & III by Chapman, Standard Publishers Distributors, New Delhi.

3. Workshop Practice by RK Singhal, SK Kataria & Sons, New Delhi.
4. Production Technology by HMT, Tata McGraw Hill, New Delhi.
5. Elements of Workshop Technology by SK Chaudhary & Hazra, Asia Publishing House.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	16
2	16	24
3	06	10
4	04	06
5	06	10
6	06	10
7	14	20
8	02	04
Total	**64**	**100**

4.5 CHASSIS, BODY AND TRANSMISSION - I

L	T	P
4	-	4

RATIONALE

Chassis, body and transmission form the core of automobile engineering. The subject focuses at imparting knowledge and skills regarding chassis and body viz. clutch system, transmission system, final drive, steering mechanism.

DETAILED CONTENTS

1. Chassis and Body (10 hrs)

Classification of vehicles, types of chassis, layout of conventional type of chassis, function and arrangement of major assemblies. Alternating arrangement used such as engine position, drive types, their merits and demerits., types of frame and body streamlining, cross members, brackets, materials of frame and body upholstery..

2. Clutch (12 hrs)

Necessity, function and requirements of clutch, types of clutch - single plate clutch, multi plate clutch, hydraulic power assisted and wet and dry plate clutch, clutch plate and lining material

Constructional details and working of centrifugal, semi centrifugal clutch, fluid coupling.

3. Transmission (14 hrs)

Necessity, function and types of manual transmission- Sliding, constant mesh and synchromesh. Over drive, over running clutch, description and operation of transfer gear box. Common faults and remedies

Types of automatic transmission and their main components

Epicyclic gear box – construction, working and determination of speed ratio

Torque converter – construction, principle of working. Continuously transmission, Automated Manual Transmission

4. Final Drive (10 hrs)

Propeller shaft – function, construction details. Universal joints - functions and types. Types of final drive – hotchkiss drive, torque tube drive. Differential – principle, functions and its working. Rear axles – semi floating, , three quarter floating. fully floating . Common faults and remedies

5. Front Axle (06 hrs)

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

6. Steering (12 hrs)

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-castor, camber, steering axis inclination, toe in and toe out. Cornering force, cornering power and self-righting torque. Over steering and under steering. Power steering – necessity, types, Construction features and working of hydraulic and electronic power steering systems, Common steering systems troubles and remedies

LIST OF PRACTICALS

1. Study and sketches of Heavy and Light vehicle chassis.
2. Identify and servicing of single plate and multi plate clutch.
3. Study and sketch of centrifugal clutch.
4. Servicing and overhauling of constant mesh and synchromesh gear box
5. Servicing of universal joints, slip joint and propeller shaft
6. Servicing of differential, adjustment of crown and pinion backlash.
7. Checking and adjustment of steering geometry, camber, caster, Toe-in, Toe-out, kingpin inclination.
8. Study of live axles.

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- II by Dr. Kirpal Singh, Standard Publishers
2. Automobile Engineering by GBS Narang, Khanna Publishers, Delhi
3. Chassis, Body and Transmission-I by G.S.Aulakh, Eagle Prakashan, Jalandhar.
4. Automobile Engineering by R.B. Gupta, Satya Prakashan, New Delhi.
5. Chassis, Body and Transmission by Ishan Publications, Jalandhar.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	10	6
2	12	18
3	14	22
4	10	16
5	06	10
6	12	18
Total	**64**	**100**

4.6 COMPUTER AIDED DRAFTING

L	T	P
-	-	3

RATIONALE

Computer aided drafting these days is extensively being used in the industry. This subject has been added to enable a diploma holder to make drawings using computer software and take prints/plots.

PRACTICE WORK

1. Introduction to AutoCAD : Starting up, practice on – how to create a new drawing file, setting drawing limits & saving a file, drawing lines in different ways using absolute co-ordinates, user co-ordinates, WCS, UCS, drawing circles, drawing arcs, drawing ellipses. Drawing polygons, drawings splines. Drawing polylines, using window, zoom commands.

2. Practice on Edit commands such as erase, copy, mirror, array, offset, rotate, oops, undo, redo, scale, stretch, trim, break, extend, chamfer, fillet, O snap command

3. Practice on Text commands: editing text, text size, text styles, change properties commands.

4. Practice on Layer Commands: creating layer, freeze, layer on/off colour assigning, current layer, load line type, lock & unlock layer, move from one layer to other.

5. Practice on Hatching, Hatch pattern selection.

6. Practice on Dimensioning, linear dimensioning, angular dimensioning radius/.diameter dimensioning O-snap command, aligned dimensioning, editing of dimensioning, tolerances in dimensioning.

7. Practice on print/plot commands. Export/import commands.

8. Practice on making complete drawings of components by doing following exercises:

   a) Detail and assembly drawing of the following using AUTOCAD (2D) (4 sheets)

      - Plummer Block
      - Wall Bracket
      - Stepped pulley, V-belt pulley
      - Flanged coupling
      - Machine tool Holder (Three views)
      - Screw jack or knuckle joint

b) Isometric Drawing by CAD using Auto CAD (one sheet)

Drawings of following on computer:
- Cone
- Cylinder
- Isometric view of objects

9. Modelling (02 sheets)

3D modelling, Transformations, scaling, rotation, translation

10. Creating Chamfer and Fillet
Practice on surface modeling, create part file, practice on assembly of parts, creating assembly view, orthographic views, section view (Practice on different views, practice on data transfer)

11. Introduction to Other Softwares;

(Pro Engineer/CATIA / Inventor/Unigraphics/Solid Work: Salient features.

INSTRUCTIONAL STRATEGY

1. Teachers should show model or realia of the component/part whose drawing is to be made.

2. Emphasis should be given on cleanliness, dimensioning, & layout of sheet.

3. Teachers should ensure use of IS codes related to drawing.

RECOMMENDED BOOKS

1. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran; Vikas Publishing House, Delhi.
2. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
3. AutoCAD 2000 for you by Umesh Shettigar and Abdul Khader; Janatha Publishers, Udupi.
4. Auto CAD 2000 by Ajit Singh, TMH, New Delhi.

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.

An internal assessment of 50 and external assessment of 50 marks 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%