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 HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P
4	-	2

RATIONALE

The subject deals with basic concepts of hydraulic and pneumatics which are required by students for automation purpose. This subject enhances the knowledge and skills of students in the area of hydraulics and pneumatics.

DETAILED CONTENTS

1. Introduction (8 hrs.)

   Need, scope and importance of hydraulic and pneumatic, Hydrostatic and hydrodynamic definitions, properties of fluid, Pascal's law, Continuity equation and Bernoulli's equation. Advantages and limitations of hydraulic and pneumatic systems

2. Hydraulic Elements (20 hrs)

   - Hydraulic Pipes- Type, materials, designations, pressure ratings and selection criteria. Piping Layout, Concept, rules/norms.
   - Hydraulic Pump- Type, construction, working applications and selection criteria. Powerpack
   - Control Valves- Type, designation, symbols, working and applications.
   - Hydraulic Actuators- Type, working and applications.
   - Other Elements such as filters, manifold, receivers, coolers and connecters.

3. Fundamentals of Pneumatics (6 hrs)

   Compressible fluid flow, mass flow rate, compressible fluid- Type, properties and applications.

4. Pneumatic Elements (20 hrs)

   - Pipes- Type, designations, applications and properties.
   - Air Compressor- Type (Reciprocating and rotary), working and selection criteria.
   - Pneumatic Cylinders- Type, symbol, cushion, assemblies, mounting and installation.
   - Air Motors- Type, working and applications.
   - Pneumatic Valves- Type, symbols, working, applications and selection criteria.
   - Other elements - Air receivers, filters, pressure regulator, lubricator.

5. Hydraulic and Pneumatic Circuits (10 hrs.)

- Concept, Meaning and ISO symbols, Basic hydraulic and pneumatic circuits- Type, circuit diagrams.
- Rules/ Norms for designing hydraulic and pneumatic circuits.

LIST OF PRACTICALS

1. Study and demonstration of various hydraulic devices/elements.
2. Study and demonstration of various pneumatic devices/elements.
3. Operate hydraulic circuits based on simple system requirement. (at least 3)
4. Operate, pneumatic circuit based on simple systems requirements (at least 3)
5. Visit to a related industry.

INSTRUCTIONAL SRATEGY

1. Teacher should lay emphasis in making the students conversant with concepts and principles of hydraulic and pneumatic systems.
2. Various hydraulic and pneumatic elements should be demonstrated during teaching.

LIST OF RECOMMENDED BOOKS

1. Hydraulics and Pneumatics (A Technician and Engineer Guide) by Andrew Parr; Butterworth Publishers.
2. Hydraulic and Pneumatic Systems by S. R Majumdar; TMH Publishers.
3. Mechatronics by W. Bolton; Pearson.
4. Hydraulic and Hydraulic Machines by R. K. Bansal
5. Industrial Pneumatic control by Z. J Lansky; Marcel Dekker, Inc.
6. Hydraulic and Pneumatic Power and control Design, Performance and Application by Yeaple; McGraw hill.
7. Pneumatic Controls: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel- Verlag

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs.)	Marks Allotted(%)
1	8	15
2	20	30
3	6	10
4	20	30
5	10	15
Total	**64**	**100**

4.3 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.

4.4 MACHINE DESIGN AND DRAWING

L	T	P
2	-	6

RATIONALE

A diploma holder in this course is required to assist in the Design and Development of Prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

DETAILED CONTENTS

1. Introduction (08 hrs)

   1.1 Design – Definition, Type of design, necessity of design

      1.1.1 Comparison of designed and undesigned work
      1.1.2 Design procedure
      1.1.3 Characteristics of a good designer

   1.2 Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.

      1.2.1 General design consideration
      1.2.2. Codes and Standards (BIS standards)

   1.3 Engineering materials and their mechanical properties :

      1.3.1 Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity, strength
      1.3.2 Selection of materials, criterion of material selection

2. Design Failure (05 hrs)

   2.1 Various design failures-maximum stress theory, maximum strain theory, maximum strain energy theory
   2.2 Classification of loads
   2.3 Design under tensile, compressive and torsional loads.

3. Design of Shaft (06 hrs)

   3.1 Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available
   3.2 Shaft subjected to torsion only, determination of shaft diameter (hollow and solid shaft) on the basis of :
      - Strength criterion
      - Rigidity criterion
   3.3 Determination of shaft dia (hollow and solid shaft) subjected to bending
   3.4 Determination of shaft dia (hollow and solid shaft) subjected to combined torsion and bending .

4. Design of Key (04 hrs)

4.1 Types of key, materials of key, functions of key
4.2 Failure of key (by Shearing and Crushing).
4.3 Design of key (Determination of key dimension)
4.4 Effect of keyway on shaft strength. (Figures and problems).

5. Design of Screwed Joints (04 hrs)

5.1 Introduction, Advantages and Disadvantages of screw joints, location of screw joints.
5.2 Important terms used in screw threads, designation of screw threads
5.3 Initial stresses due to screw up forces, stresses due to combined forces
5.4 Design of power screws (Press, screw jack, screw clamp)

6. Cams (03 hrs)

6.1 Types of cams and followers (theoretical)
6.2 Profile of cams for imparting following motion with knife edge and roller followers
- Uniform motion
- Simple harmonic motion
- Uniformity accelerated and retarded motion

7. Gears (02 hrs)

7.1 Nomenclature of gears and conventional representation
7.2 Drawing the actual profile of involute teeth gear by different methods

Note : The paper setter should provide all the relevant data for the machine design numericals in the question paper.

INSTRUCTIONAL STRATEGY

1. While imparting instructions, focus should be on concepts.
2. Presentation should be arranged for various topics.

RECOMMENDED BOOKS

1. Machine Design by R.S. Khurmi and JK Gupta, Eurasia Publishing House (Pvt.) Limited, New Delhi.
2. Machine Design by V.B.Bhandari, Tata McGraw Hill, New Delhi.
3. Engineering Design by George Dieter; Tata McGraw Hill Publishers, New Delhi.
4. Mechanical Engineering Design by Joseph Edward Shigley; McGraw Hill, Delhi.
5. Machine Design by Sharma and Agrawal; Katson Publishing House, Ludhiana.
6. Design Data Handbook by D.P. Mandali, SK Kataria and Sons, Delhi.

7. Machine Design by A.P.Verma; SK Kataria and Sons, Delhi

8. Machine Design by AR Gupta and BK Gupta ; Satya Parkashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2	05	06
3	06	16
4	04	10
5	04	32
6	03	12
7	02	12
Total	**32**	**100**

4.5 WORKSHOP TECHNOLOGY-II

L	T	P
3	-	-

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, tools, jigs and fixtures and processing of plastics is required to be imparted. Hence the subject of workshop technology.

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (04 hrs)

   1.1. Cutting Tools - Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect, Heat produced during cutting and its effect, Cutting speed, feed and depth of cut and their effect

   1.2 Cutting Tool Materials - Properties of cutting tool material, Study of various cutting tool materials viz. High-speed steel, tungsten carbide, cobalt steel cemented carbides, stellite, ceramics and diamond.

2. Lathe (12 hrs)

   2.1 Principle of turning
   2.2 Function of various parts of a lathe
   2.3 Classification and specification of various types of lathe
   2.4 Work holding devices
   2.5 Lathe tools and operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning.
   2.6 Cutting parameters – Speed, feed and depth of cut for various materials and for various operations, machining time.
   2.7 Speed ratio, preferred numbers of speed selection.
   2.8 Lathe accessories:- Centers, dogs, different types of chucks, collets, face plate, angle plate, mandrel, steady rest, follower rest, taper turning attachment, tool post grinder, milling attachment, Quick change device for tools.
   2.9 Introduction to capstan and turret lathe

3. Drilling (06 hrs)

   3.1 Principle of drilling.
   3.2 Classification of drilling machines and their description.
   3.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
   3.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
   3.5 Types of drills and their features, nomenclature of a drill
   3.6 Drill holding devices.

4. Boring (04 hrs)

4.1 Principle of boring
4.2 Classification of boring machines and their brief description.
4.3 Boring tools, boring bars and boring heads.

5. Shaping, Planing and Slotting (04 hrs)

5.1 Working principle of shaper, planer and slotter.
5.2 Type of shapers
5.3 Type of planers
5.4 Types of tools used and their geometry.
5.5 Speeds and feeds in above processes.

6. Broaching (04 hrs)

6.1 Introduction
6.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.
6.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.

7. Jigs and Fixtures (06 hrs)

7.1 Importance and use of jigs and fixture
7.2 Principle of location
7.3 Locating devices
7.4 Clamping devices
7.5 Advantages of jigs and fixtures

8. Cutting Fluids and Lubricants (08 hrs)

8.1 Function of cutting fluid
8.2 Types of cutting fluids
8.3 Difference between cutting fluid and lubricant
8.4 Selection of cutting fluids for different materials and operations
8.5 Common methods of lubrication of machine tools.

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes.

2. Focus should be on preparing jobs using various machines in the workshop

RECOMMENDED BOOKS

1. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons; Delhi
2. Elements of Workshop Technology by SK Choudhry and Hajra; Asia Publishing House
3. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi
4. Workshop Technology by R.C. Jindal; North Publication, Ishan Publishers

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	8
2	12	26
3	06	14
4	04	8
5	04	8
6	04	8
7	06	12
8	08	16
Tot1al	**48**	**100**

4.6 WORKSHOP PRACTICE – II

L	T	P
-	-	9

PRACTICAL EXERCISES

Turning Shop

Job 1. Grinding of single point turning tool.

Job 2. Exercise of simple turning and step turning.

Job 3. A composite job involving, turning, taper turning, external thread cutting and knurling.

Advance Fitting Shop

Job 1. Exercise on drilling, reaming, counter boring, counter sinking and taping

Job 2. Dove tail fitting in mild steel

Job 3. Radius fitting in mild steel

Job 4. Pipe threading with die

Machine Shop

Job 1. Prepare a V-Block up to ± 0.5 mm accuracy on shaper machine

Job 2. Exercise on key way cutting and spline cutting on shaper machine.

INDUSTRIAL TRAINING OF STUDENTS

(During summer vacation after IV Semester)

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which 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. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of a minimum of 4 weeks duration to be organised during the semester break starting after second year i.e. 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 minimum of one visit per week 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.