

**0917 – DIPLOMA IN MECHANICAL ENGINEERING
SEMESTER – IV
SYLLABUS**

091741 - MATERIALS AND METALLURGY

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RATIONALE

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

DETAILED CONTENTS

1. Importance of Materials

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

2. Metallurgical Considerations

Solidification of metals from liquid to solid state of pure metals, cooling curves of pure metals, dendritic solidification, crystal formation, types of crystal structure. Phase diagram of:

- (i) Solid-state solubility.
- (ii) Partial solubility.
- (iii) Nil solubility i.e. eutectic solution (Binary only). Effects of all alloying elements on engineering materials. Effect of grain size on mechanical properties.

3. Ferrous Metals and Alloys

- Flow diagram for the production of ferrous metals from their ores, constituents of iron, iron carbon diagram.
- Classification, composition and uses of cast iron and plain carbon steels. IS, BS and SAE Grades
- Effect of alloying elements such as Aluminium, chromium, Nickel, Cobalt, Manganese, Molybdenum, tungsten, Vanadium, Silicon, Sulphur and Phosphorous on steels.
- Composition, properties, grades and uses of special steels such as High speed steel, Stainless steels, Silicon steels, Heat resistant steels, Spring steel.
- Heat Treatment: Iron-carbon diagram, objectives and practical aspects of heat treatment. Brief description and uses with examples of principal heat treatment processes, Annealing, Normalizing, Tempering, Hardening, Carburising, Nitriding and Cyaniding and applications. Examples in heat-treating engineering components time, temperature transformation curve.

4. Non-ferrous Metals and Alloys

- Copper: Properties and uses
- Composition, properties and uses of copper alloys.
- Brasses: Cartridge brass, Nickel silver.
- Bronzes: Phosphor bronze, Al-bronze, Mn-bronze, and Gun metal.
- Properties and uses of Aluminium.
- Composition, properties and uses of Al-alloys e.g., Duralumin, Yellow metal, Magnalium and Hindalium
- Properties and uses of alloys of lead, tin and magnesium.

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

5. Identification and Examination of Metals and Alloys (1 hrs)

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

6. Other Important Materials

- Plastics: Definition, classification of plastics, fibre glass, reinforced plastics. Major applications of various plastics and their uses and grades.
- Composite materials.
- Heat insulating materials: Properties and uses of asbestos, glass wool, thermocole, cork, mica.
- Electrical insulating materials. Properties and uses of china clay, leather, bakelite, ebonite, glass wool, rubber, felt.
- Sound insulating materials: Cork, fibre boards.
- Fabrication materials: Wood, plywood, rubber – natural and synthetic, Glass – plate glass, toughened glass, safety glass.
- Refractory materials: General characteristics and uses of dolomite, ceramics.
- Protective coating materials: Paints, primers, varnishes, enamels, putti, electroplating materials, rubasil, teflon coating.
- Sealant and adhesives – Application and availability of sealant and adhesives for industrial user.

7. Selection, specifications and commercial availability of materials

- Practical considerations for selection of material for different purposes

- ISO/Bureau of Indian standard specifications for metals, non- metals, various components and materials.

LIST OF PRACTICALS

1. Classification of about 25 specimen of materials/parts in material lab, identify and indicate the type of materials with respect to their properties
2. Study of metallurgical microscope.
3. To prepare microscopic structure for examination and to examine the micro structure of specimens of various metals and alloys.
4. Study of heat treatment furnaces.
5. To study the effects of heat treatments processes on the following materials:
 - (i) Low carbon steel
 - (ii) Mild steel
 - (iii) High Carbon Steel

RECOMMENDED BOOKS

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

091742 - HYDRAULICS AND HYDRAULIC MACHINES

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DETAILED CONTENTS

RATIONALE

Diploma holders in Mechanical Engineering are required to deal with problems of fluid flow and use of hydraulics in power generation. For this purpose, knowledge and skills about fluid mechanics, fluid flow and hydraulic machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about various properties of fluids, measurement of various flow parameters and about various hydraulic machines.

DETAILED CONTENTS

1. Introduction

Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility.

2. Pressure and its Measurement

- 2.1 Concept of Pressure (Atmospheric Pressure, gauge pressure, absolute pressure)
- 2.2 Pressure measuring devices: peizometer tube, manometers - simple U-tube, differential single column, inverted U-tube, micromanometer
- 2.3 Bourdon pressure gauge
- 2.4 Simple problems

3. Flow of Fluids

Types of fluid flow-steady and unsteady, uniform and non-uniform, laminar and turbulent; rate of flow and their units; continuity equation of flow; Bernoulli's theorem (without proof) and its applications, Discharge measurement with the help of venturimeter, orifice meter and pitot tube, simple problems

4. Flow through orifices

C_c , C_v , C_d , flow through drowned, partially drowned orifices, time for emptying a tank through a circular orifice. Simple problems

5. Flow through pipes

- Definition of pipe flow, wetted perimeter, hydraulic mean depth, hydraulic gradient; loss of head due to friction; Chezy's equation and Darcy's equation of head loss.
- Loss of head in pipes due to sudden enlargement, sudden contraction, obstruction on flow path, change of direction and pipe fittings, Simple problems

6. Hydraulic Devices

Description, operation and application of hydraulic machines – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press,

7. Water Turbines and Pumps

- Concept of a turbine, types of turbines –impulse and reaction. Construction and working of pelton wheel, Francis turbine and Kaplan turbine
- Concept of hydraulic pump.
- Construction, working and operation of reciprocating pump and centrifugal pump.

LIST OF PRACTICALS

1. Measurement of pressure head by employing
 - i) Piezometer tube
 - ii) Single and double column manometer
 - iii) Pressure gauge
2. To find out the value of coefficient of discharge for a venturimeter
3. Measurement of flow by using venturimeter
4. Verification of Bernoulli's theorem
5. To determine the coefficient of friction of pipe using Darcy's equation.
6. Study the working of a pelton wheel and Francis turbine

7. Dismantling and assembly of a single stage centrifugal pump to study its constructional details, operation including fault diagnosis.

RECOMMENDED BOOKS

1. Hydraulics and Hydraulic Machines by RS Khurmi ; S.Chand & Co. Ltd., New Delhi.
2. Hydraulics and Fluid Mechanics by Jagdish Lal; Metropolitan Book Company Ltd., Delhi.
3. Fluid Mechanic, Hydraulics and Hydraulic Machines by K.K. Arora; Standard Publishers Distributors, Delhi.
4. Fluid Mechanics, Hydraulics and Fluid Machines by S. Ramamruthan; Dhanpat Rai and Sons, Delhi.

RATIONALE

A Mechanical diploma holder can get employment in automobile manufacturing sector. He must have knowledge of constructional details of engine, its assembly and dismantling & other systems of different types of automobiles. He can also get employment in Power Plants and other Industries involving boilers and application of steam. So after studying this subject, he would be able to take up these assignments in various industries.

DETAILED CONTENTS

1. IC Engines

- Introduction and classification of IC engine
- Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, diesel cycle and dual cycle
- Location and functions of various parts of IC engines and materials used for them
- Concept of IC engine terms: bore, stroke, dead centre, crank throw, compression ratio, clearance volume, piston displacement and piston speed

2. Fuel Supply and Ignition System in Petrol Engine

- Concept of carburetion
- Air fuel ratio
- Simple carburetor and its application
- Working of Solex and Amal carburetor (line sketch) and its advantages over simple carburetor
- Description of battery coil and magneto ignition system
- Recent developments in fuel supply system - MPFI, electronic ignition system

- Increasing the efficiency by adopting super charging & turbo charging
3. Fuel System of Diesel Engine
 - Component of fuel system
 - Description and working of fuel feed pump
 - Fuel injection pump
 - Injectors
 4. Cooling and Lubrications
 - Function of cooling system in IC engine
 - Air cooling and water cooling system, use of thermostat, radiator and forced circulation in water cooling (description with line diagram)
 - Function of lubrication
 - Types and properties of lubricant
 - Lubrication system of IC engine
 5. Testing of IC Engines
 - Engine power - indicated and brake horse power
 - Efficiency - mechanical, thermal. relative and volumetric
 - Methods of finding indicated and brake power
 - Morse test for petrol engine
 - Heat balance sheet
 - Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers - EURO - I, EURO -II, their Indian version, methods of reducing pollution in IC engines alternative fuels like - CNG, LPG
 6. Steam Turbines and Steam Condensers
 - Function and use of steam turbine

- Steam nozzles - types and applications
- Steam turbines - impulse, reaction, simple and compound, construction and working principle
- Governing of steam turbines
- Function of a steam condenser, elements of condensing plant
- Classification - jet condenser, surface condenser
- Condenser vacuum, vacuum efficiency, condenser efficiency
- Cooling pond and cooling towers

7. Steam Power Plant

- Main parts and working of power plant with simple line diagram, coal handling system, pulverized coal firing system, ash handling and disposal system, cooling towers
- Use of feed water heater, economizer, air pre-heater, re- heating and regeneration and dust collector
- Heat balance and efficiency

8. Gas Turbines and Jet Propulsion

- Classification, open cycle gas turbine and closed cycle gas turbines, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbines
- Open cycle constant pressure gas turbines - general layout. PV and TS diagram and working of gas turbines
- Closed cycle gas turbines, PV and TS diagram, working of gas turbines
- Principle of operation of ram- jet engine and turbo jet engine - application of jet engines
- Rocket engine -its principle of working and applications
- Fuels used in jet propulsion

LIST OF PRACTICALS

1. Dismantle a two stroke engine, note the function and material of each part, reassemble the engine
2. Dismantle a single cylinder diesel engine. Note the function of each part, reassemble the engine
3. Dismantle Solex, Amal carburetor, locate' and note down the functions of various parts, re-assemble
4. Study of battery ignition system of a multi-cylinder petrol engine stressing ignition timings, setting, fixing order and contact breaker; gap adjustment .
5. Study of lubricating system of IC engine
6. Determination of BHP by dynamometer
7. Morse test on multi-cylinder petrol engine
8. To prepare heat balance sheet for diesel/petrol engine
9. Local visit to roadways or private automobile workshops
10. Study of steam turbines through models and visit
11. Study of steam condensers through model and visits
12. Performance test of engine by full throttle and part throttle

RECOMMENDED BOOKS

1. Elements of Heat Engines by Pandey and Shah; Charotar Publishing House, New Delhi.
2. Thermal Engineering by PL.Ballaney; Khanna Publishers, New Delhi.
3. Engineering Thermodynamics by Francis F Huang; MacMillan Publishing Company.

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. Milling
 - Specification and working principle of milling machine
 - Classification, brief description and applications of milling machines
 - Details of column and knee type milling machine
 - Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment, spiral milling attachment, slotting attachment and rack milling attachment.
 - Milling methods - up milling and down milling
 - Identification of different milling cutters and work mandrels
 - Work holding devices
 - Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.
 - Cutting speed and feed, depth of cut.
 - Indexing on dividing heads, plain and universal dividing heads.
 - Indexing methods: direct, Plain or simple, compound differential and angular indexing.
 - Cutting fluids used in milling.
2. Grinding

- Purpose of grinding
 - Specifications of grinding wheel – Abrasive, Grade, structure, Bond
 - Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
 - Truing, dressing, balancing and mounting of wheel.
 - Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
 - Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
 - Selection of grinding wheel
 - Cutting fluids used in grinding.
3. Shaping, Planing and Slotting
- Working principle of shaper, planer and slotter.
 - Quick return mechanism applied to shaper, slotter and planer machine.
 - Specification of shaper, planer and slotting machine.
 - Speeds, feeds and depth of cut.
4. Broaching
- Introduction
 - Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.
 - Elements of broach tool, broach teeth details – nomenclature, types, tool material.
5. Metal Forming Process
- Press Working

- a) Press working – Types of presses, type of dies, selection of press die, die material
- b) Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping
- Forging
 - a) Open die forging, closed die forging
 - b) Cold and hot forging
- Rolling
 - a) Elementary theory of rolling
 - b) Types of rolling mills
 - c) Rolling defects and remedies
- Extrusion and Drawing
 - a) Type of extrusion- Hot and Cold, Direct and indirect
 - b) Pipe drawing, tube drawing

RECOMMENDED BOOKS

1. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons, Delhi.
2. Manufacturing Technology by M.Adithan and AB Gupta; New Age International (P) Ltd, Delhi.
3. Workshop Technology Vol. I, II, III by Chapman; Standard Publishers Distributors, New Delhi.
4. Practical Handbook for Mechanical Engineers by Dr. AB Gupta; Galgotia Publications, New Delhi.
5. Workshop Technology by R.C Jindal; Ishan Publications, Ambala city.
6. Production Engineering and Science by Pandey and Singh; Standard Publishers Distributors, New Delhi.
7. Workshop Practice by R.K. Singal, S K Kataria and Sons, New Delhi.

8. A text Book of Production Engineering by P.C. Sharma; S. Chand and Company Ltd., New Delhi.
9. Production Technology by HMT; Tata McGraw Publishers, New Delhi.

091745 – MACHINE DESIGN AND DRAWING

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RATIONALE

A diploma holder in this course is required to assist in the design and development of prototype and other equipments. For this, it is essential, that he is made conversant with the principles related to design of components and application of these principles for designing and prepare drawing of the same and hence this subject.

DETAILED CONTENT

1. Introduction

- Design - Definition, types of designs necessity of design.
- Comparison of designed and undersigned work.
- Design procedure.
- Practical examples related with design procedure.
- Characteristics of a good designer.
- Characteristics of environment required for a designer.
- Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.,
- General design considerations.
- Codes and standards.

2. Design of keys and shafts.

Design of keys: Types of keys, materials of keys, and functions of keys.
Design of keys.

Design of shafts: Types of shaft, type of loading on shafts, shaft materials, Effect of keyway on shaft strength, Design of shafts under various loading.

3. Design of Joints

- Types of joints: Temporary and permanent, utility of joints.
- Permanent joints.
- Welded joints.
- Types of welded joints, strength of parallel and transverse fillet welds.
- Strength of combined parallel and transverse welds.
- Axially loaded welded joints.
- Riveted joints: rivet materials, rivet heads, leak proofing of riveted joints – caulking and fullering.
- Different modes of rivet joint failure.
- Design of riveted joints: lap, butt, diamond (Lozenzo).
- Design of boiler joints i.e. circumferential and longitudinal boiler joints.

4. **Design of Couplings**

- Necessity of a coupling, advantages of a coupling and types of couplings, design of flanged couplings.

5. **Assembly Drawing of the following**

- Tool post.
- Bench-vice.
- Safety valve.

6. **Cams**

- Cam profile nomenclature.
- Types of followers.
- Motions of followers.
- To draw cams with different followers with different motions.

7. **Gears**

- Types of gears.
- Nomenclature of gears.
- Conventional representation of gears.
- Draw profile of spur gear.

RECOMMENDED BOOKS

1. Machine Design by Pandya and Shah.
2. Machine Design by Sharma and Aggarwal; Katson Publishing House, Ludhiana.
3. Machine Design by R.S. Khurmi & J.K. Gupta; Eurasia Publishing House (Pvt.) Ltd.
4. Design of Machine elements by V.B. Bhandari; Tata Mc Graw Hill; Delhi.
5. Engineering Design by George Dieter; Tata Mc Graw Hill; Delhi.
6. Mechanical Engineering Design by Joseph Edward Shigley, Mc Graw Hill.
7. Machine Design by Sadhu Singh.
8. Machine Design by G.R. Nagpal.
9. Machine Design Data Book.

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

1. Produce a rectangular block by face milling and prepare a slot on one face with a slotting cutter / side and face cutter.
2. Gear manufacturing by some indexing device on a milling machine & gear hobber. Inspection of gear
3. Job on grinding using
 - Surface grinding
 - Cylindrical grinding
 - Centreless grinding
4. Milling cutter grinding on tool and cutter grinder.
5. Prepare a V-block to ± 0.2 mm accuracy on shaper machine.
6. Exercise on key way cutting and spline cutting.
7. Preparation of job through eccentric turning.
8. Practice of taper turning.
9. Exercise on EDM for preparation of electrodes(male and female).

Note: The workshop Superintendent will finalize the specific drawings of all the jobs in the beginning of semester in consultation with staff

RATIONALE

Today age is computer age. Most of our daily activities are being influenced by the use of computers. While in areas like science and technology, improvements cannot be achieved without computers. It has become necessary for each and everyone of us to have a basic knowledge of application of computers. PowerPoint is a feature packed presentation programme whereas access is database management systems. Programming is backbone for preparing various technological projects, which can be achieved by C++ language – most versatile one in today’s scenario. This subject is being offered to acquaint the students about MS PowerPoint, MS Access and Programming using C++ language.

DETAILED CONTENT

1. Computer Application Overview
 - Commercial and business data processing applications
 - Engineering computation
2. MS PowerPoint
 - 2.1 Introduction
 - Elements of power point package- templates, wizards, views, color schemes
 - Starting PowerPoint
 - Exploring PowerPoint menus
 - Starting a new slide
 - Adding title, text and art
 - Moving text area and resizing text box
 - Starting a slide show
 - Saving a presentation

- Printing slides
- Inserting and deleting slides
- Closing a presentation
- Exercise for making a presentation and slide show

2.2 Views

- PowerPoint views – slide view, outline view, slide sorter view, notes view, slide show view, slide setup
- Zoom in, zoom out
- Exercises on various views of presentation

2.3 Formatting and Enhancing text

- Formatting
- Changing format with a new layout
- Alignment of text and text spacing
- Enhancing text formatting – use of bullets, changing text font and size
- Selecting text style and color
- Applying design template
- Closing and applying the transition
- Spell checking
- To set header and footer
- Exercise on formatting text and applying design template.

2.4 Slide with graphs.

- Creating a graph

- Adding graphic objects
- Adding clipart pictures
- Adding movies and sounds
- Adding multimedia to presentation
- Inserting excel worksheet or word table
- Exercise on inserting graphs, tables, movies and clipart.

3 MS - Access

3.1 Introduction to Microsoft access

- Components of access

3.2 Table creating

- Starting access, creating tables, tool bars and views of tables
- Editing the design and contents of the table
- Creating relationship between tables
- Adding OLE objects to a table
- Use of import and export facility
- Exercise on table creating

3.3 Query Handling

- Creating a new query, use of criteria, expressions and operation
- Editing a query, print a query
- Exercise on creating and editing query

3.4 Form designing

- Introduction, creating a form, modify a form design, designing a form using design view.
- Sub – forms, printing the forms, exercise on form designing.

3.4 Report designing

- Creating a report, managing the different controls of the records, saving and printing the report, use of graphs in reports
- Exercise on report designing

4 Programming fundamentals

- Algorithm, pseudo language, flow charts: advantages and disadvantages
- Decision table – type, advantages and disadvantages
- Structured programming: structuring the control flow, modular programming
- Exercise on making algorithm and flow charts.

5 C++ programming

5.1 Fundamentals

- Introduction, oop, character set, C++ tokens, keywords, identifiers, constants, basic data type, declaration of variables, defining symbolic constants, assignment statement, comments in a programme, structure of C++ programme, output using COUT, output using CIN, manipulators.

5.2 Operators and Expressions

- Arithmetic operators, relational operators, logical operators, shorthand assignment operator, increment and decrement operators, conditional operators, bit wise operators, precedence in C++ operators, casting of data, standard mathematical functions.

5.3 Control structures

- IF statements, IF---ELSE statements, nested IF statements, switch statements, Go To statements, repetitive structures, while statements, do statement, for loop, break statement, continue statement, nested loops.

5.4 Programs

- Write a program to check if a number is even or odd.
- Write a program to find the smallest of 3 numbers.
- Write a program to find largest of 4 numbers
- Write a program to find the roots of quadratic equation.
- Write a program to find the sum of the first N natural numbers using a for – do loops.
- Write a program that reads in N numbers and finds the smallest number among them.
- Write a program to find the sum of squares of the digits of a number.

6. Demonstration of CNC machine.

RECOMMENDED BOOKS

1. MS Office 2000 for everyone by Sanjay Saxena; Vikas Publishing House Pvt. Ltd.
2. MS Office 2000 by Steve Hill; BPB Publications.
3. Programming in C++ by B. Subharamanayam.
4. Programming in C by Abdul Khader; Ajanata Publications

INDUSTRIAL TRAINING

Industrial Training aims at exposing the students to field practices, size and scale of operation and work culture at practical sites. For this purpose, students at the end of fourth semester are required to be sent for a period of 4 weeks to industry.

Each student is supposed to study the material and technology used at site and prepares a detailed report of the observation of process seen by him/her. These students should be supervised and guided by respective subject teachers. Each teacher may guide a group of four to five students.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following.

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