

FOURTH SEMESTER :

Sr. No.	SUBJECTS	STUDY SCHEME		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
		Periods/Week			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
4.1	*English and Communication Skills - II	2	2	2+1=3	40	40	80	60	60	120	200
4.2	Materials and Metallurgy	3	2	3+1=4	40	40	80	60	60	120	200
4.3	Hydraulics and Pneumatics	3	2	3+1=4	40	40	80	60	60	120	200
4.4	Workshop Technology – III	3	-	3+0=3	40	-	40	60	-	60	100
4.5	Machine Design	3	-	3+0=3	40	-	40	60	-	60	100
4.6	Thermodynamics II	3	2	3+1=4	40	40	80	60	60	120	200
4.7	Workshop Practice – III	-	6	0+3=3	-	40	40	-	60	60	100
4.8	CAD/CAM	-	4	0+2=2	-	40	40	-	60	60	100
# Student Centered Activities(SCA)		-	-	-	-	-	-	-	-	-	-
Total		17	18	26	240	240	480	360	360	720	1200

* Common with other Diploma Courses

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Industrial/In-house Training: After 4th Semester, students shall undergo Summer Training of minimum 4 Weeks.

FOURTH SEMESTER

4.1	English and Communication Skills - II	112-115
4.2	Materials and Metallurgy	116-119
4.3	Hydraulics and Pneumatics	120-122
4.4	Workshop Technology – III	123-125
4.5	Machine Design	126-128
4.6	Thermodynamics II	129-132
4.7	Workshop Practice – III	133-134
4.8	CAD/CAM	135-136

4.1 ENGLISH AND COMMUNICATION SKILL - II

L	P
2	2

RATIONALE

Communication II moves a step further from Communication Skills I and is aimed at enhancing the linguistic competency of the students. Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life – personal, social and professional. This course is intended to make fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

- CO1: Communicate effectively with an increased confidence; read, write and speak in English language fluently.
- CO2: Comprehend special features of format and style of formal communication through various modes.
- CO3: Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews
- CO4: Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

- 1.1 Techniques of reading: Skimming and Scanning
- 1.2 Extensive and Intensive Reading
- 1.3 The Portrait of a Lady - Khushwant Singh
- 1.4 'The Doctor's Word' by R K Narayan
- 1.5 Speech by Dr Kiran Bedi at IIM Indore 2007 Leadership Concepts
- 1.6 The Bet - by Anton Chekov

UNIT II**Effective Communication Skills**

- 2.1 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)
- 2.2 Effective Communication Skills: 7 C's of Communication
- 2.3 Non-verbal Communication – Significance, Types and Techniques for Effective Communication
- 2.4 Barriers and Effectiveness in Listening Skills
- 2.5 Barriers and Effectiveness in Speaking Skills

Unit III**Professional Writing**

- 3.1 Correspondence: Enquiry letters, placing orders, complaint letters
- 3.2 Report Writing
- 3.3 Memos
- 3.4 Circulars
- 3.5 Press Release
- 3.6 Inspection Notes
- 3.7 Corrigendum writing
- 3.8 Application for Job
- 3.9 Tips for Note-taking
- 3.10 Drawing inferences

UNIT IV**Grammar and Vocabulary**

- 4.1 Prepositions
- 4.2 Conjunctions
- 4.3 Punctuation
- 4.4 Idioms and Phrases
- 4.5 Pairs of words (Words commonly misused and confused)
- 4.6 Translation of Administrative and Technical Terms in Hindi or Mother tongue

UNIT V**Employable Skills**

- 5.1 Presentation Skills: How to prepare and deliver a good presentation
- 5.2 Telephone Etiquettes
- 5.3 Importance of developing employable and soft skills

- 5.4 Resume Writing: Definition, Kinds of Resume, Difference between Bio-data and Curriculum Vitae and Preparing a Resume for Job/ Internship
- 5.5 Group discussions: Concept and fundamentals of GD, Functional and Non-functional roles in GD and learning Group Dynamics.

PRACTICAL EXERCISES

1. Reading Practice of the above lessons in the Lab Activity classes.
2. Comprehension exercises of unseen passages along with the above lessons.
3. Vocabulary enrichment and grammar exercises based on the above selective readings.
4. Situational Conversation: Requesting and Responding to requests; Expressing sympathy and condolence.
5. Warning; Asking and giving information.
6. Getting and giving permission.
7. Asking for and giving opinions.
8. A small formal and informal speech.
9. Seminar.
10. Debate.
11. Unseen Comprehension Passages and vocabulary enhancement.
12. Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.
13. Written and Oral Drills will be undertaken in the class to facilitate a holistic linguistic competency among learners.
14. Participation in a GD and Personal or Telephonic Interview
15. Presentations, using audio-visual aids (including power-point).
16. Telephonic interviews, face to face interviews.
17. Presentations as Mode of Communication: Persuasive Presentations using multi-media aids.

RECOMMENDED BOOKS

1. Practical J Sethi, Kamlesh Sadanand & DV Jindal, “Course in English Pronunciation”, PHI Learning Pvt. Ltd., New Delhi.
2. JK Gangal, “A Practical Course in Spoken English”, PHI Learning Pvt. Ltd., New Delhi.
3. NK Aggarwal and FT Wood, “English Grammar, Composition and Usage”, Macmillan Publishers India Ltd., New Delhi.

4. RC Sharma, and Krishna Mohan, “Business Correspondence & Report Writing”, (4th Edition), by Tata MC Graw Hills, New Delhi.
5. Varinder Kumar, Bodh Raj & NP Manocha, “Business Communication Skills”, Kalyani Publisher, New Delhi.
6. Kavita Tyagi & Padma Misra, “Professional Communication”, PHI Learning Pvt. Ltd., New Delhi.
7. Nira Konar, “Communication Skills for Professionals”, PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan & Meera Banerji, “Developing Communication Skills”, (2nd Edition), Macmillan Publishers India Ltd., New Delhi.
9. M. Ashraf Rizwi, “Effective Technical Communication”, Tata MC Graw Hills, New Delhi.
10. Andrea J Rutherford, “Basic Communication Skills for Technology”, Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. This subject contains units of equal weight age.

4.2 MATERIALS AND METALLURGY

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3 2

RATIONALE

Lot of development has 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.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

- C01: Distinguish between metals and non metals and ferrous and non ferrous materials.
- C02: Analyze microstructure and changes in microstructure due to heat treatment.
- C03: Carryout various heat treatment processes.
- C04: Draw and interpret iron-carbon diagram.
- C05: Distinguish various grades of Stainless steel and the relative selection of fabrication process depending upon the metallurgy of SS
- C06: Classify various types of plastics and rubber.
- C07 Explain properties and applications of composites, ceramics and smart materials.
- C08 Select suitable material to be used for various engineering applications.

DETAILED CONTENTS

UNIT I

1. Introduction

Material: Engineering materials, Overview of different engineering materials and applications, Importance, Classification of materials, Difference between metals and non-metals, Overview of Biomaterials and semi-conducting materials

UNIT II**2. Crystallography**

Fundamentals: Crystalline solid and amorphous solid, 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, coordination number (without derivation), Defects/Imperfections, types and effects in Solid materials.

Deformation: Overview of deformation behaviour and its mechanisms, Elastic and Plastic deformation. Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep.

3. Metallurgy

Introduction, Cooling curves of pure metals, dendritic solidification of metals, effect of grain size on mechanical properties, Binary alloys, Thermal equilibrium diagrams, Lever rule, Solid Solution alloys

UNIT III**4. Metals and Alloys**

Ferrous Metals: Different iron ores, Flow diagram for production of iron ,steel and stainless steel, allotropic forms of iron- Alpha, Delta, Gamma. Basic process of manufacturing of pig iron and steel-making.

Cast Iron: Properties, types of Cast Iron, manufacture and their use.

Steels: Plain carbon Steels and alloy steel, Classification of plain carbon steels, Properties and application of different types of Plain Carbon Steels, Effect of various alloying elements on properties of steel, Uses of alloy steels (high speed steel, silicon steel, spring steel)

Stainless steel: Definition, importance and criticality (Life cycle cost, Corrosion impact; difference with Steel, Per Capita consumption; growth rate of SS vs other materials, World vs India). Various grades of SS and their nomenclature, Effect of alloying elements, Unique characteristics of various grades of SS

Manufacturing of SS: Process flow, Raw materials for SS manufacturing functions of each processing unit, Downstream facilities, Various finishes of SS.

Fabrication and testing of SS: Stud welding method, Weldability and effect of welding on various types of SS, Defects like Sensitization and microfissure, Relative observations and precautions while performing the processes: cutting , Buffing, Bending, Roll forming, Embossing, Polishing of Stainless steel. Chemical treatment like pickling and passivation for SS.

Applications of SS : Demand of SS in various segments, Overview of SS applications in Automobile, railway, and transport. Architectural, building construction applications and Process Industries.

Non Ferrous Materials: Properties and uses of Copper, Aluminium and their alloys

UNIT IV

5. Heat Treatment

Definition and objectives of heat treatment, Iron carbon equilibrium diagram, different microstructures of iron and steel. Formation and decomposition of Austenite, Martensitic Transformation. Various heat treatment processes- hardening, tempering, annealing, normalizing, surface hardening, carburizing, nitriding, cyaniding. Hardenability of Steels

Types of heat treatment furnaces (only basic idea), measurement of temperature of furnaces. Physical metallurgy of Stainless Steel; Various phases in SS, Chromium-Nickel diagram, Schaeffler Diagram

UNIT V

6. Advanced Materials

Heat Insulating materials- Asbestos, glasswool, thermocole.

Refractory materials –Dolomite, porcelain.

Glass – Soda lime, borosil.

Materials for bearing metals Materials for Nuclear Energy

Smart materials- properties and applications.

PRACTICAL EXERCISES

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, SS, Gun metal); identify and indicate the various properties possessed by them.

3.
 - a) Study of heat treatment furnace.
 - b) Study of a thermocouple/pyrometer.
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 (At least any two):
 - i) Brass ii) Copper iii) Cast Iron, iv) Mild Steel v) HSS, vi) Aluminium vii) Stainless steel
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.
9. Demo of welding defects like sensitization and microfissure in stainless steel.

RECOMMENDED BOOKS

1. R.K. Rajput, “Text book of Material Science”, Katson Publishers, Ludhiana.
2. V.K. Manchanda and GBS Narang, “Text book of Material Science”, Khanna Publishers, New Delhi.
3. A.R. Gupta, “Introduction to Material Science”, Satya Prakashan, New Delhi.
4. S. K. Hazra Chaudhary, “Material Science and Processes”, India Book Distribution Co., Calcutta, First Edition, 1977.

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of engineering materials to the students. Visits to industry should be planned to demonstrate use of various types of materials or heat treatment processes in the industry. This is hands-on practice based subject and topics taught in the class should be practiced in the lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

4.3 HYDRAULICS AND PNEUMATICS

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RATIONALE

Diploma holders in this course are required to deal with properties of fluid and use of hydraulics and pneumatics in power generation and industries. For this purpose, knowledge and skills about fluid mechanics and machinery, hydraulics and pneumatics systems are required to be imparted for enabling them to perform above functions.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Explain fluid properties, their units and conversion.

CO2: Measure pressure using appropriate pressure measuring devices.

CO3 : Measure flow & discharge rate using appropriate flow measuring devices.

CO4 : Describe the construction and working of turbines.

CO5: Describe the construction and working of pumps.

CO6: Explain the functions of various components used in hydraulic and pneumatic system.

DETAILED CONTENTS

UNIT I

1. Properties of fluid

Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility. Fluid Pressure & Pressure Measurement: Fluid pressure, of Pascal's law and its applications Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Piezometer, Simple U- tube Manometer and differential manometers, Bourdan's pressure gauge, Concept of Total pressure on immersed bodies, center of pressure, Simple problems on fluid properties and Manometers.

UNIT II**2. Fluid Flow**

Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli's theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems.

Flow Through Pipes: Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, wetted perimeter, Hydraulic gradient and total gradient line, Reynold's number and its effect on pipe friction; Water hammer. Simple numerical problems to estimate major and minor losses

UNIT III**3. Hydraulic Turbines**

Impact of jet on fixed vertical and moving vertical flat plates, Hydraulic Turbines:

Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines. other Machines working construction and applications of hydraulic press, hydraulic jack, hydraulic accumulator and hydraulic ram.

UNIT IV**4. Pumps**

Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

UNIT V**5. Hydraulic and Pneumatic systems**

Introduction to oil power hydraulic and pneumatic system. Relative Merits and Demerits of oil power hydraulic and pneumatic system. Basic components of hydraulic system, function of each component in a hydraulic circuit such as Oil reservoirs, connectors, pipes, motors and pumps(power pack), Filters, etc.

Components of Pneumatic Systems : Basic components – function of each component such as Air compressors, Air cylinder and their types (single acting, double acting, piston type, diaphragm type, tandem cylinder, double ended cylinder). Air filter, regulator and lubricator – their necessity in pneumatic circuit. common faults in hydraulic system and pneumatic systems and remedial action.

PRACTICAL EXERCISES

1. Measurement of pressure head using
 - i) Piezometer tube
 - ii) Simple U-tube manometer
 - iii) Bourdon.s tube pressure gauge
2. Verification of Bernoulli's theorem.
3. Determination of Coefficient of Discharge of venturimeter.
4. Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orifice meter.
5. Determination of coefficient of friction of flow through pipes((Darcy's equation)
6. Determination of minor losses of flow through pipes. (Chezy's Equation)
7. To determine overall efficiency of a single stage centrifugal pump.
8. Demo of working of Pelton wheel, Francis and Kaplan turbine with the help of working model.
9. Draw hydraulic circuit of any available machine or working model
10. Draw pneumatic circuit of any available machine or working model

RECOMMENDED BOOKS

1. S.S. Rattan, "Fluid Mechanics & Hydraulic Machines", Khanna Publishing House, New Delhi.
2. KL Kumar, "Fluid Mechanics", S Chand and Co Ltd., Ram Nagar, New Delhi.
3. P.N. Modi and S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House. New Delhi
4. R K Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publication, New Delhi.
5. Andrew Parr, "Hydraulics and Pneumatics: A Technician's and Engineer's Guide", Butterworth-Heinemann.
6. S. Majumdar, "Pneumatic Systems: Principles and Maintenance", McGraw Hill.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching-learning
2. Expose students to real life problems
3. Plan assignments so as to promote problem solving abilities and develop continued learning skills. This subject contains five units of equal weightage.

4.4 WORKSHOP TECHNOLOGY - III

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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 and modern machining methods is required to be imparted. Hence this subject.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

- CO1: To understand the concept of gear manufacturing using different methods.
- CO2: To understand grinding and finishing processes.
- CO3: Explain the working and applications of modern machining practices.
- CO4: Explain the working principle of metal forming.
- CO5: Explain the working principle of metallic coating and finishing processes.

DETAILED CONTENTS

UNIT I

1. Gear Manufacturing

Gear materials and specifications, Gear manufacturing by Casting, Moulding, Stamping, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes;

UNIT II

2. Grinding

Principles of metal removal by Grinding; Abrasives – Natural & Artificial; Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite; Factors affecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Standard marking systems: Meaning of letters & numbers sequence of marking, Grades of letters; Truing, dressing, balancing and mounting of wheel. Selection of grinding wheel. Grinding machines classification: Cylindrical, Surface, Tool

& Cutter grinding machines; Construction details; Principle of centreless grinding; Advantages & limitations of centreless grinding;

UNIT III

3. Modern Machining Processes

Introduction – comparison with traditional machining; Ultrasonic Machining: principle, Description of equipment, applications; Electric Discharge Machining (EDM): Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications. Wire cut EDM: Principle, Description of equipment, Controlling parameters; applications; Abrasive Jet Machining: principle, description of equipment, application; Laser Beam Machining: principle, description of equipment, application; Electro Chemical Machining: description of equipment, application.

UNIT IV

4. Metal Forming Processes

Press Working - Types of presses, type of dies and punches, selection of press die, die material. Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping.

Forging - Open die forging, closed die forging, Press forging, upset forging, swaging, up setters, roll forging, Cold and hot forging.

Rolling - Elementary theory of rolling, Types of rolling mills, Thread rolling, roll passes, Rolling defects and remedies.

Extrusion and Drawing - Type of extrusion- Hot and Cold, Direct and indirect. Pipe drawing, tube drawing, wire drawing

UNIT V

5. Metal Finishing Processes

Purpose of finishing surfaces. Surface roughness-Definition and units, Honing Process, its applications, Description of hones. Brief idea of honing machines. Lapping process, its applications. Description of lapping compounds and tools. Brief idea of lapping machines. Polishing, Buffing, Burnishing and super finishing

6. Metallic Coating Processes

Metal spraying – Wire process, powder coating process, applications, Electroplating: Basic principles, Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing. Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating; Finishing specifications.

RECOMMENDED BOOKS

1. P N Rao, “Manufacturing Technology Vol.-I &II”, Tata McGraw-Hill Publications.
2. S. K. Hajra Chaudhary, Bose and Roy, “Elements of Workshop Technology (Volume I and II)”, Media Promoters and Publishers Limited.
3. O. P. Khanna & Lal, “Production Technology (Volume I & II)”, Dhanpat Rai Publications.
4. BL Juneja, GS Sekhon and Nitin Seth, “Fundamental of Metal Cutting and Machine Tools”, New Age International Limited.
5. R. K Jain, “Production Technology”, Khanna Publication, New Delhi
7. Raghuwanshi, “Workshop Technology Vol.-II”, Khanna Publishers, New Delhi.
8. B. L. Juneja, “Fundamental of Metal Forming”, New Age International Limited, Delhi.

INSTRUCTIONAL STRATEGY

Teachers should lay special emphasis in making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes. Use of audio-visual aids/video films should be made to show specialized operations. This subject contains five units of equal weightage.

4.5 MACHINE DESIGN

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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.

COURSE OUTCOMES

At the end of this course, students will be able to:

- CO1: Explain the terms related to design.
- CO2: Design shaft on the basis of strength and rigidity.
- CO3: Design keys and couplings
- CO4: Design temporary and permanent joints
- CO5: Design screw jack and helical spring.

DETAILED CONTENTS

UNIT I

1. Introduction

- 1.1 Design – Definition, Type of design, necessity of design, Comparison of designed and undesigned work, Design procedure, 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, creep and tenacity, endurance limit. SN Curve and its significance
- 1.3 General design consideration, Selection of materials, criteria of material selection, Codes and Standards (BIS standards)
- 1.4 Various design failures- maximum normal stress theory, maximum stress theory, maximum strain theory

UNIT II**2. Design of Shaft**

- 2.1 Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available
- 2.2 Shaft subjected to torsion only, determination of shaft diameter (hollow and solid shaft) on the basis of :
 - Strength criterion
 - Rigidity criterion
- 2.3 Determination of shaft diameter (hollow and solid shaft) subjected to bending
- 2.4 Determination of shaft diameter (hollow and solid shaft) subjected to combined torsion and bending.

UNIT III**3. Design of Key**

- 3.1 Types of key, materials of key, functions of key
- 3.2 Failure of key (by Shearing and Crushing).
- 3.3 Design of key (Determination of key dimension)
- 3.4 Effect of keyway on shaft strength. (Figures and problems).

4. Design of Coupling

Necessity of a coupling, advantages of a coupling, types of couplings, design of muff coupling, design of flange coupling. (Both protected type and unprotected type).

UNIT IV**5. Design of Joints**

- Types of joints - Temporary and permanent joints, utility of various joints
- 5.1 Design of Temporary Joints:
 - Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems).
 - Cotter Joint – Different parts of the spigot and socket joints, Design of spigot and socket joint.
 - 5.2 Design of Permanent Joint:
 - Riveted Joints. : Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering.
 - Different modes of rivet joint failure.
 - Design of riveted joint – Lap and butt, single and multi riveted joint.
 - Welded Joint - Welding symbols. Type of welded joint, strength of parallel and transverse fillet welds.

Strength of combined parallel and transverse weld.

UNIT V

6. Design of Screwed Joints and Springs

- 6.1 Design of screw: Introduction, Advantages and Disadvantages of screw joints, location of screw joints. Important terms used in screw threads, designation of screw threads, Initial stresses due to screw up forces, stresses due to combined forces, Design of Screw jack
- 6.2 Design of Spring: Classification and applications of springs, spring terminology, Stresses in springs, Wahl's correction factor, design of open coil helical spring subjected to uniform applied load under tension and compression.

Note: a) Use of design data book during the examination is allowed.

b) The paper setter should normally provide all the relevant data for the machine design in the question paper.

RECOMMENDED BOOKS

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

INSTRUCTIONAL STRATEGY

While teaching, teacher should use models of various parts/components. This subject contains five units of equal weightage.

4.6 THERMODYNAMICS-II

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RATIOANLE

A diploma holder in this course is supposed to know about working and testing of IC Engines, fuel supply, ignition system, cooling and lubrication of engines and working of steam turbine and gas turbine. Hence this subject

COURSE OUTCOMES

After undergoing this course, the students will be able to:

- CO1: Explain the working of IC engine and functioning of various parts of IC engine.
- CO2: Explain the working of fuel supply and ignition system in petrol engine.
- CO3: Explain the functioning of different components of fuel supply of diesel engine.
- CO4: Explain the working of lubrication and cooling system in IC engine.
- CO5: Assist in testing an IC engine and understand pollution norms in India.
- CO6: Explain the functioning of steam turbine, gas turbine and jet propulsion.

DETAILED CONTENTS

UNIT I

1. IC Engines

- 1.1 Introduction and classification of IC engine
- 1.2 Description of Carnot cycle, Otto cycle, diesel cycle with PV and TS diagram
- 1.2 Working principle of two stroke and four stroke cycle, SI engines and CI engines
- 1.3 Location and functions of various parts of IC engines and materials used for them
- 1.4 Basic terms such as bore, TDC, BDC, Stroke, Crank throw, piston speed and compression ratio
- 1.5 Valve timing diagram for four stroke CI and SI engines
- 1.6 Comparison between SI and CI engines, comparison between two stroke and four stroke engines

2. Fuel Supply and Ignition System in Petrol Engine

- 2.1 Concept of carburetion
- 2.2 Air fuel ratio, mixture required at different conditions and loads on engine.
- 2.3 Simple carburetor and its limitations and application. Working of Solex carburetor.
- 2.4 Description of petrol injection system (MPFI)
- 2.5 Description of battery coil and electronic ignition system

UNIT II**3. Fuel System of Diesel Engine**

- 3.1 Components of fuel supply system of Diesel engine
- 3.2 Description and working of fuel feed pump, Fuel injection pump, fuel injectors and fuel filters
- 3.3 Types of Fuel injection systems in diesel engine

4. Cooling and Lubrication

- 4.1 Function of cooling system in IC engine
- 4.2 Air cooling and water cooling system, use of thermostat and radiator.
- 4.3 Function and types of coolant
- 4.4 Function of lubrication
- 4.5 Lubrication system of IC engine

UNIT III**5. Testing of IC Engines**

- 5.1 Engine power - indicated and brake power
- 5.2 Efficiency - mechanical, thermal. relative and volumetric
- 5.3 Methods of finding indicated and brake power
- 5.4 Morse test for petrol engine
- 5.5 Heat balance sheet, simple numerical problems
- 5.6 Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers. Bharat stage emission standards (BS Norms), Methods of reducing pollution in IC engines

UNIT IV**6. Steam Turbines and Steam Condensers**

- 6.1 Introduction, main parts, uses and classification of steam turbine
- 6.2 Construction and working principle of impulse and reaction steam turbines and comparison

- 6.3 Governing of steam turbines
- 6.4 Steam nozzles - types and applications
- 6.5 Function of a steam condenser, elements of condensing plant and types of steam condenser (Jet and surface).
- 6.6 Comparison between jet condenser and surface condenser
- 6.7 Cooling pond and cooling towers

UNIT V

7. Gas Turbines and Jet Propulsion

- 7.1 Classification, open cycle gas turbine and closed cycle gas turbine, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbine
- 7.2 Open cycle constant pressure gas turbines - general layout, PV and TS diagram and working of gas turbine
- 7.3 Closed cycle gas turbines, PV and TS diagram and working
- 7.4 Principle of operation of ram-jet engine and turbo jet engine - application of jet engines
- 7.5 Supercharger and turbocharger engine

PRACTICAL EXERCISES

1. Dismantle an IC engine and note down the condition of various parts, removal and fitting of piston, rings, measuring of bore size, crank shaft ovality and assemble it.
2. Dismantling and assembling a carburetor
3. Servicing of petrol engine.
4. Demonstration of electronic ignition system
5. Valve servicing, grinding, lapping and fitting mechanism and tappet adjustment.
6. Service of water cooling system of IC engine and note down the functioning/testing of various components.
7. Determination of BHP by dynamometer.
8. Morse test on multi-cylinder petrol engine.
9. Testing of engine pollution.

Note : Visit to a thermal power plant may be arranged.

RECOMMENDED BOOKS

1. Pandey and Shah, “Elements of Heat Engines”, Charotar Publishing House, Anand.
2. PL. Ballaney, “Thermal Engineering”, Khanna Publishers, New Delhi.
3. Francis F Huang, “Engineering Thermodynamics”, McMillan Publishing Company, Delhi.
4. CP. Arora, “Engineering Thermodynamics”, Tata McGraw Hill Publishers, New Delhi.
5. RK Purohit, “Thermal Engineering”, Standard Publishers Distributors, New Delhi.
6. V Ganeshan, “Internal Combustion Engine and Gas Turbine”, Tata McGraw Hill.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

4.7 WORKSHOP PRACTICE - III

L P
- 6

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, skills in operating various machines are required to be developed. Hence the subject of workshop practice.

COURSE OUTCOMES:

After undergoing this course, the students will be able to:

CO1: Prepare jobs using various conventional and advance machines.

CO2: Carry out metal coating and finishing operations.

CO3: Undertake advance fitting operations.

PRACTICAL EXERCISES

GRINDING SHOP

1. Job on grinding machine using a surface grinder.
2. Prepare a job on cylindrical grinding machine.
3. Grinding a drill-bit on tool and cutter grinder.
4. Prepare a job on centerless grinding machine.
5. Exercise on dressing a grinding wheel.

ADVANCE MACHINE SHOP

1. Prepare a slot on one face using milling machine
2. Prepare a T slot on vertical milling machine.
3. Prepare a job on milling machine by using a form cutter
4. Prepare a spur gear on a hobbing machine
5. Perform machining operation on EDM/wire cut machine.
6. Demonstration of modern machining processes such as ECM/USM/LBM etc. through industrial visit.
7. Demo of metal forming operations such as Forging, Extrusion, Rolling, Press Working etc. through industrial visit.

METAL COATING AND FINISHING SHOP

1. Prepare a job by using metal finishing operations such as-lapping, buffing, polishing, burnishing on a workpiece.
2. Prepare a job to finish an internal surface using honing process.
3. Carry out electroplating on a job.
4. Finishing a metal surface using a metal spray
5. Finishing a metal surface using powder Coating

ADVANCE FITTING SHOP

1. Exercise of drilling, reaming, counter boring, counter sinking and tapping operations.
2. Prepare dove tail fitting on mild steel specimen.
3. Prepare radius fitting on mild steel specimen
4. Perform pipe threading operation using die and assembly of the same with pipe fittings.

RECOMMENDED BOOKS

1. B.S. Raghuwanshi, “Workshop Technology”, Dhanpat Rai and Sons, Delhi.
2. S.K. Choudhry and Hajra, “Elements of Workshop Technology”, Asia Publishing House.
3. PC Sharma, “A Textbook of Production Engineering”, S. Chand and Company Ltd. Delhi.

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students. Instructor should conduct classes of each Workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

4.8 CAD/ CAM

L P
- 4

RATIONALE

Manufacturing of this century belongs to computerized equipment & machine tools to manufacture a variety of components with high quality, high precision & low cost at a faster rate. Computer Aided Designing, Computer Aided Manufacturing, are the part of Computer Integrated Manufacturing which help to achieve the desired goals in manufacturing. After completing the subject, the students will be able to know about these integrated techniques which help a manufacturer to achieve his goal within stipulated time.

COURSE OUTCOMES:

After undergoing this course, the students will be able to:

CO1: Draw 2D drawings of various parts using drafting software.

CO2: Draw 3D drawings using any part modelling software.

CO3: Generate part programs using CAM software.

PRACTICAL EXERCISES

- 1. Computer Aided Design (CAD) (03 Sheets)**
- 1.1 Introduction to Computer Aided Drafting (2D) commands of any one software (Auto CAD, ProE, Solid works, Unigraphics etc.)
- 1.2 Introduction to CAD Software, Installing CAD Software, Familiarization with software, coordinate system (Absolute, Relative and Polar), snap, grid, and ortho mode and setting of units and layout.
- 1.3 Exercises on preparing drawings of some machine elements using: Drawing commands – point, line, arc, circle, ellipse, Editing commands – scale, erase, copy, stretch, lengthen and explode.
- 1.4 Dimensioning and placing text in drawing area, sectioning and hatching, Inquiry for different parameters of drawing entity, Create layers within a drawing,
- 1.5 Some exercise on simple drawings.

2. Prepare assembly drawing of the following using Drafting Software (2D) (3 sheets)

- 2.1 Plummer Block
- 2.2 Stepped pulley, V-belt pulley
- 2.3 Machine tool Holder
- 2.4 Wall Bracket

3. Isometric Drawing by CAD using any part modeling Software (3D) (2 sheets)

Introduction: Part modelling: Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient. Exercises for 3D Drawings:

- 3.1. Flanged coupling
- 3.2. Bearing Block
- 3.3. Bushed bearing

4. Computer Aided Manufacturing (CAM)

- 4.1. Introduction to CAM software, steps in using CAM software
- 4.2. Generate part program using CAM software (MasterCAM/EdgeCAM or any other CAM software) for turning jobs
- 4.3. Generate part program using CAM software (MasterCAM/EdgeCAM or any other CAM software) for milling jobs

RECOMMENDED BOOKS

1. P. Radhakrishnan, S. Subramaniyan and V. Raju, “CAD/CAM/CIM”, New Age International Pvt. Ltd., New Delhi.
2. P.S. Gill, “Machine Drawing”, S. K. Kataria & Sons, Delhi.
3. T. Jeyapooran, “Engineering Drawing with AutoCAD 2000”, Vikas Publishing House, Delhi.
4. Instruction Manual of the Software (AutoCAD, ProE, Solidworks, Unigraphics etc.).

INSTRUCTIONAL STRATEGY

Emphasis should be laid on hands-on practice for development of required skills in the students.

