

COMPETENCY BASED CURRICULUM

DIPLOMA IN MECHANICAL ENGINEERING

(Duration 3 Years)

NSQF Level – 4



**Under
Haryana State Board of Technical Education**



Developed By

**Curriculum Development Center
National Institute of Technical Teachers Training & Research
(Ministry of Education, Government of India)
Sector - 26, Chandigarh, UT, India.**

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12. STUDY AND EVALUATION SCHEME

THIRD 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	
3.1	Industrial/In-house Training-I	-	2	0+1=1	-	40	40	-	60	60	100
3.2	Strength of Materials	3	2	3+1=4	40	40	80	60	60	120	200
3.3	Mechanical Engineering Drawing II	-	6	0+3=3	-	40	40	-	60	60	100
3.4	Thermodynamics - I	3	2	3+1=4	40	40	80	60	60	120	200
3.5	Workshop Technology – II	3	-	3+0=3	40	-	40	60	-	60	100
3.6	Basics of Electrical and Electronics Engineering	2	-	2+0=2	40	-	40	60	-	60	100
3.7	Workshop Practice – II	-	6	0+3=3	-	40	40	-	60	60	100
3.8	Open Elective (MOOCs ⁺ /Offline)	2	-	2+0=2	40	-	40	60	-	60	100
# Student Centered Activities(SCA)		-	4	-	-	-	-	-	-	-	-
	Total	13	22	22	200	200	400	300	300	600	1000

+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

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.

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.

13. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial/In-house Training I	2	-
2.	Strength of Materials	5	-
3.	Mechanical Engineering Drawing II	6	-
4.	Thermodynamics I	5	-
5.	Workshop Technology – II	3	-
6.	Basics of Electrical & Electronics Engineering	2	-
7.	Workshop Practice II	6	-
8.	Open Elective (MOOCs/Offline)	2	-
9.	English and Communication Skills II	-	4
10.	Materials and Metallurgy	-	5
11.	Hydraulics and Pneumatics	-	5
12.	Workshop Technology – III	-	3
13.	Machine Design	-	3
14.	Thermodynamics II	-	5
15.	Workshop Practice III	-	6
16.	CAD/CAM	-	4
17.	Student Centred Activities	4	-
Total		35	35

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to Mechanical Engineering require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They are expected to have factual knowledge of Mechanical Engineering field. They will be able to write and speak with required clarity. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools.

Skilled workers will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They should work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment.

Mechanical Engineering NSQF Level – 4 pass out students are expected have the knowledge of properties and testing of materials. They are expected to have good knowledge of thermodynamics. They are also expected to have good knowledge and skills in drawing and design of mechanical components. Level 4 pass out students should have good knowledge and skills regarding working of various machines.

Mechanical Engineering students have a wide scope to work in manufacturing industries primarily in private sector and to some extent in public sector. In addition, they have job avenues in railways, hospitals, military engineering services, boards and corporations, construction companies, transportation departments, telecommunication, P W D and rural development agencies. They have wide scope in establishing small startups in the area of marketing and sales, manufacturing units and repair and maintenance units etc.

15. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

- PO1:** Carry out a task which may require limited range of predictable activities.
- PO2:** Acquire knowledge of basic facts, process and principles related to Mechanical Engineering for employment.
- PO3:** Demonstrate practical skill in narrow range of Mechanical Engineering applications.
- PO4:** Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.
- PO5:** Perform task under close supervision with some responsibility for own work within defined limit.
- PO6:** Select open elective of own interest to develop self-learning through MOOCs.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	<ul style="list-style-type: none"> • Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries.
PO2: Acquire knowledge of basic facts, process and principles related to Mechanical Engineering for employment.	<ul style="list-style-type: none"> • Understand the working environment of industries. • Learn about present and future requirement of industries. • Interpret various concepts and terms related to strength of materials • Calculate stresses in thin cylindrical shells. • Calculate energy stored by materials subjected to axial loads. • Calculate moment of inertia of different sections. • Draw and calculate bending moment and shear force diagrams of beam under given loading • Interpret the concept of bending and torsion and calculate stresses on different section of materials. • Calculate critical axial loads on column under different end constraints. • Determine the various parameters in closed coil helical and laminated springs • Interpret different limits and fits of components

	<ul style="list-style-type: none"> • Read and interpret drawings of mechanical components • Interpret gear terminology and draw spur gear teeth profile. • Apply thermodynamic laws. • Solve basic problems of gas equation using perfect gas laws. • Explain the working, construction and applications of steam boilers and steam generators • Determine various properties of steam • Determine enthalpy, specific heat capacity of an ideal and real gas. • Explain the working, construction and application of air compressor. • Demonstrate applications of various welding processes. • Explain the process of pattern making, moulding and casting • Explain procedure of various types of NDT for welding and casting. • Explain the working of various machining processes such as shaping, planning, milling and broaching • Understand functions and operations of various jigs and fixtures. • Interpret various electrical quantities. • Improve power factor in a given circuit. • Explain construction, working principle, and applications of transformer. • Identify different wires of distribution system. • Describe the working of single phase and three phase motors. • Follow electrical safety measures. • List the applications of diodes and ICs.
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	<ul style="list-style-type: none"> • Distinguish between metals and non metals and ferrous and non ferrous materials. • Carryout various heat treatment processes. • Draw and interpret iron-carbon diagram. • Distinguish various grades of Stainless steel and the relative selection of fabrication process depending upon the metallurgy of SS • Classify various types of plastics and rubber. • Explain properties and applications of composites, ceramics and smart materials. • Select suitable material to be used for various engineering applications. • Explain fluid properties, their units and conversion. • Measure pressure using appropriate pressure measuring devices. • Measure flow & discharge rate using appropriate flow measuring devices. • Describe the construction and working of turbines. • Describe the construction and working of pumps. • Explain the functions of various components used in hydraulic and pneumatic system. • To understand the concept of gear manufacturing using different methods. • To understand grinding and finishing processes. • Explain the working and applications of modern machining practices. • Explain the working principle of metal forming.
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	<ul style="list-style-type: none"> • Explain the working principle of metallic coating and finishing processes. • Explain the terms related to design. • Design shaft on the basis of strength and rigidity. • Design keys and couplings • Design temporary and permanent joints • Design screw jack and helical spring. • Explain the working of IC engine and functioning of various parts of IC engine. • Explain the working of fuel supply and ignition system in petrol engine. • Explain the functioning of different components of fuel supply of diesel engine. • Explain the working of lubrication and cooling system in IC engine. • Explain the functioning of steam turbine, gas turbine and jet propulsion.
PO3: Demonstrate practical skill in narrow range of Mechanical Engineering applications.	<ul style="list-style-type: none"> • Understand the working environment of industries. • Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries. • Perform various tests related to strength on various machines as per Indian Standards. • Draw different kind of machine components like bearings, brackets, pulleys, pipe joints and lathe tool holder. • Read and interpret drawings of mechanical components

	<ul style="list-style-type: none"> • Prepare assembly drawings of mechanical machine parts like jig, vices & screw jack. • Prepare assembly drawings of boiler and I.C. engine parts. • Interpret gear terminology and draw spur gear teeth profile. • Solve basic problems of gas equation using perfect gas laws. • Prepare jobs on lathe, shaper, planer and milling machines. • Carry out welding of parts. • Carry out pattern making, moulding and casting operations. • Analyze microstructure and changes in microstructure due to heat treatment. • Carry out various heat treatment processes. • Measure pressure using appropriate pressure measuring devices. • Measure flow & discharge rate using appropriate flow measuring devices. • Design shaft on the basis of strength and rigidity. • Design keys and couplings • Design temporary and permanent joints • Design screw jack and helical spring. • Assist in testing an IC engine and understand pollution norms in India. • Prepare jobs using various conventional and advance machines. • Carry out metal coating and finishing operations. • Undertake advance fitting operations. • Draw 2D drawings of various parts using drafting software. • Draw 3D drawings using any part modelling software. • Generate part programs using CAM software.
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<p>PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.</p>	<ul style="list-style-type: none"> • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships. • Develop writing, speaking and presentation skills. • Assist in testing an IC engine and understand pollution norms in India.
<p>PO5: Perform task under close supervision with some responsibility for own work within defined limit.</p>	<ul style="list-style-type: none"> • Take necessary safety precautions and measures. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries.
<p>PO6: Select open elective of own interest to develop self-learning through MOOCs.</p>	<ul style="list-style-type: none"> • State the basic concepts and principles about the subject of interest. • Perform in a better way in the professional world. • Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses.

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1	Industrial/In-house Training-I	89-90
3.2	Strength of Materials	91-94
3.3	Mechanical Engineering Drawing II	95-97
3.4	Thermodynamics - I	98-100
3.5	Workshop Technology – II	101-104
3.6	Basics of Electrical and Electronics Engineering	105-107
3.7	Workshop Practice – II	108-109
3.8	Open Elective (MOOCs/Offline)	110-111

3.1 INDUSTRIAL/IN-HOUSE TRAINING- I

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RATIONALE

This Industrial training / In – house training is very important to give industrial exposure to the students. It will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. It will also help the students in development of required competencies and skills for employment and start – ups.

COURSE OUTCOMES

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

- CO1: Understand the working environment of industries.
- CO2: Take necessary safety precautions and measures.
- CO3: Learn about present and future requirement of industries.
- CO4: Work in team for solving industrial problems.
- CO5: Develop competencies and skills required by relevant industries.
- CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training.
3. Power Point Presentation based on industrial training.
4. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
5. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries

GUIDELINES

In this session students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point Presentation about the knowledge and skills gained during the training. The Head of the department can create coordinators by assigning 5 - 6 students to each. The coordinators may guide the students in preparing the PPTs for final presentation. The coordinator may consider the following performance parameters for assessment of the students out of 100 marks:

	Parameter	Weightage
i	Punctuality & Behavior	20%
ii	Report Writing	30%
iii	Presentation	30%
iv	Viva - voce	20%

3.2 STRENGTH OF MATERIALS

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3	2

RATIONALE

Diploma holders in this course are required to analyze reasons for failure of different components and select the required material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

COURSE OUTCOMES

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

- CO1: Interpret various concepts and terms related to strength of materials
- CO2: Calculate stresses in thin cylindrical shells.
- CO3: Calculate energy stored by materials subjected to axial loads.
- CO4: Calculate moment of inertia of different sections.
- CO5: Draw and calculate bending moment and shear force diagrams of beam under given loading
- CO6: Interpret the concept of bending and torsion and calculate stresses on different section of materials.
- CO7: Calculate critical axial loads on column under different end constraints.
- CO8: Determine the various parameters in closed coil helical and laminated springs
- CO9: Perform various tests related to strength on various machines as per Indian Standards.

DETAILED CONTENTS

UNIT I

1. Stresses and Strains

- 1.1. Basic concept of load, stress and strain
- 1.2. Tensile, compressive and shear stresses
- 1.3. Linear strain, Lateral strain, Shear strain, Volumetric strain.
- 1.4. Concept of Elasticity, Elastic limit and limit of proportionality
- 1.5. Hook's Law, Elastic Constants and their relation (without derivation)

- 1.6. Stress-strain curve for ductile and brittle materials
- 1.7. Nominal stress
- 1.8. Yield point, plastic stage
- 1.9. Ultimate stress and breaking stress
- 1.10. Percentage elongation
- 1.11. Proof stress and working stress
- 1.12. Factor of safety
- 1.13. Poisson's Ratio
- 1.14. Thermal stress and strain
- 1.15. Longitudinal and circumferential stresses in seamless thin walled cylindrical shells.
- 1.16. Introduction to Principal stresses

2. Resilience

- 2.1. Strain Energy, Resilience, proof resilience and modulus of resilience
- 2.2. Strain energy due to direct stresses and Shear Stress
- 2.3. Stresses due to gradual, sudden and falling load.

UNIT II

3. Moment of Inertia

- 3.1. Concept of moment of inertia and second moment of area
- 3.2. Radius of gyration
- 3.3. Theorem of perpendicular axis and parallel axis (with derivation)
- 3.4. Second moment of area of common geometrical sections: Rectangle, Triangle, Circle (without derivation); Second moment of area for L,T and I section
- 3.5. Section modulus

UNIT III

4. Bending Moment and Shearing Force

- 4.1. Various types of beams and form of loading
- 4.2. End supports-Roller, hinged and fixed
- 4.3. Concept of bending moment and shearing force
- 4.4. B.M. and S.F. Diagram for simply supported beam with and without overhang subjected to concentrated and U.D.L and cantilever beam.

UNIT IV**5. Bending Stresses**

- 5.1 Concept of Bending stresses
- 5.2 Theory of simple bending, Derivation of Bending Equation
- 5.3 Use of the equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$
- 5.4 Concept of moment of resistance
- 5.5 Bending stress diagram
- 5.6 Section modulus for rectangular, circular and symmetrical I section.
- 5.7 Calculation of maximum bending stress in beams of rectangular, circular, and T section.

6 Columns

- 6.1 Concept of column, modes of failure
- 6.2 Types of columns, modes of failure of columns
- 6.3 Buckling load, crushing load
- 6.4 Slenderness ratio
- 6.5 Effective length
- 6.6 End restraints
- 6.7 Factors effecting strength of a column
- 6.8 Strength of column by Euler Formula without derivation
- 6.9 Rankine Gourdan formula (without derivation)

UNIT V**7. Torsion**

- 7.1 Concept of torsion, difference between torque and torsion.
- 7.2 Derivation of Torsion Equation, use of torsion equation for circular shaft, (solid and hollow)
- 7.3 Comparison between solid and hollow shaft with regard to their strength and weight.
- 7.4 Concept of mean and maximum torque
- 7.5 Power transmitted by shaft

8. Springs

- 8.1 Closed coil helical springs subjected to axial load and calculation of Stress deformation, Stiffness and angle of twist and strain energy, Strain energy and proof resilience.
- 8.2 Determination of number of plates of laminated spring (semi elliptical type only)

PRACTICAL EXERCISES

1. Tensile test on bars of Mild steel and Aluminum.
2. Bending test on a steel bar or a wooden beam.
3. Impact test on metals
 - a) Izod test
 - b) Charpy test
4. Torsion test of solid specimen of circular section of different metals for determining modulus of rigidity.
5. To plot a graph between load and extension and to determine the stiffness of a helical spring.
6. Hardness test on different metals.

Note : All the tests need to be done as per prescribed Indian Standards.

RECOMMENDED BOOKS

1. RS Khurmi, “Strength of Materials”, S.Chand & Co, New Delhi.
2. Dr. Kirpal Singh, “Mechanics of Materials”, Standard Publishers Distribution, New Delhi.
3. Birinder Singh, “Strength of Materials”, Katson Publishing House, New Delhi.
4. D.R. Malhotra and H.C.Gupta, “Elements of SOM”, Satya Prakashan, New Delhi.

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.

3.3 MECHANICAL ENGINEERING DRAWING II

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- 6

RATIONALE

Diploma holders in Mechanical Engineering are required to interpret drawings and therefore it is essential that they have skills of preparing drawings and sketches of mechanical components. This subject aims at development of drawing skills in the students.

COURSE OUTCOMES

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

- CO1: Interpret different limits and fits of components
- CO2: Draw different kind of machine components like bearings, brackets, pulleys, pipe joints and lathe tool holder.
- CO3: Read and interpret drawings of mechanical components
- CO4: Prepare assembly drawings of mechanical machine parts like jig, vices and screw jack
- CO5: Prepare assembly drawings of boiler and I.C. engine parts.
- CO6: Interpret gear terminology and draw spur gear teeth profile.

DETAILED CONTENTS

1. **Limit, fits and tolerance (02 sheet)**
Need of limit, fits and tolerance, Maximum limit of size, minimum limit of size, tolerance, allowance, deviation, upper deviation, lower deviation, fundamental deviation, clearance, maximum clearance, minimum clearance. Fits – clearance fit, interference fit and transition fit. Hole basis system, shaft basis system, tolerance grades, calculating values of clearance, interference, hole tolerance, shaft tolerance with given basic size for common assemblies like H₇/g₆, H₇/m₆, H₈/p₆. Basic terminology and symbols of geometrical dimensioning and tolerances. Surface finish representation
2. **Drawing of the following with complete dimensions, tolerances, bill of material and surface finish representation.**
 - 2.1 Universal coupling and Oldham coupling (Assembly) (02 sheets)
 - 2.2 Bearings (04 sheets)

- 2.2.1 Bushed Bearing (Assembly Drawing)
- 2.2.2 Ball Bearing and Roller Bearing (Assembled Drawing)
- 2.2.3 Plummer Block (Detail and Assembly Drawing)
- 2.2.4 Foot step Bearing (Assembled Drawing)
- 2.3 Pipe Joints (03 sheets)
 - 2.3.1 Types of pipe Joints, Symbol and line layout of pipe lines
 - 2.3.2 Expansion pipe joint (Assembly drawing)
 - 2.3.3 Flanged pipe and right angled bend joint (Assembly Drawing)
- 2.4 Reading and interpretation of mechanical components and assembly drawings
- 2.5 Sketching practice of wall bracket. (01 sheet)

- 3. Drilling Jig (Assembly Drawing) (01 sheet)**

- 4. Machine vices (Assembly Drawing) (03 sheets)**
 - Lathe Tool Holder (Assembly Drawing)
 - Lathe tail stock (assembly drawing)

- 5. I.C. Engine Parts (03 sheets)**
 - Piston
 - Connecting rod (Assembly Drawing)
 - Crankshaft and flywheel (Assembly Drawing)

- 6. Boiler Parts (02 sheets)**
 - Steam Stop Valve (Assembly Drawing)
 - Blow off cock. (Assembly Drawing)

- 7. Mechanical Screw Jack (Assembled Drawing) (01 sheet)**

- 8. Gears (02 sheets)**
 - Gear, Types of gears, Nomenclature of gears and conventional representation
 - Draw the actual profile of involute teeth of spur gear by approximate method and base circle method.

RECOMMENDED BOOKS

1. P.S. Gill, “Machine Drawing”, S.K. Kataria and Sons, Ludhiana.
2. R.K. Dhawan, “A Text Book of Machine Drawing”, S. Chand and Co. Ltd New Delhi.
3. N.D. Bhatt, “Machine Drawing”, Charotar Book Depot, Anand.
4. Bhattacharya, “Machine Drawing”, Oxford Press, New Delhi.

INSTRUCTIONAL STRATEGY

The teachers should first demonstrate then assist the students to prepare drawing sheets.

Note:-

- (1) First angle projection should be followed, 20% of drawings may be prepared in third angle projection.
- (2) SP-46-1988 should be followed.
- (3) The drawing should include discussion with tolerances, whenever necessary and material list as per BIS / ISO specifications.
- (4) At least 18 sheets may be prepared covering all the topics.

3.4 THERMODYNAMICS - I

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3	2

RATIOANLE

A diploma holder in this course is supposed to maintain steam generators, turbines, compressors and other power plant equipment. Therefore, it is essential to impart him basic concepts of thermodynamics, steam generators, steam turbines, and compressors and about IC engines.

COURSE OUTCOMES

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

- CO1: Apply thermodynamic laws.
- CO2: Solve basic problems of gas equation using perfect gas laws.
- CO3: Explain the working, construction and applications of steam boilers and steam generators
- CO4: Determine various properties of Steam
- CO5: Determine enthalpy, specific heat capacity of an ideal and real gas.
- CO6: Explain the working, construction and application of air compressor.

DETAILED CONTENTS

UNIT I

1. Fundamental Concepts

Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy and internal energy.

2. Laws of Perfect Gases

Definition of gases, explanation of perfect gas laws – Boyle's law, Charle's law, Avagadro's law, Regnault's law, Universal gas constant, Characteristic gas constants and its derivation.

Specific heat at constant pressure, specific heat at constant volume of a gas, derivation of an expression for specific heats with characteristics, simple numerical problems on gas equation.

UNIT II**3. Thermodynamic Processes**

Types of thermodynamic processes – isochoric, isobaric, isothermal, adiabatic, isentropic, polytropic and throttling processes, equations representing the processes

Derivation of work done, change in internal energy, change in entropy, rate of heat transfer for the above processes

UNIT III**4. Laws of Thermodynamics**

Laws of conservation of energy, first law of thermodynamics (Joule's experiment) and its limitations, Steady flow energy equation, Application of steady flow energy equation for turbines, pump, boilers, compressors, nozzles, and evaporators.

Heat source and sink, statements of second laws of thermodynamics: Kelvin Planck's statement, Classius statement, equivalency of statements, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility and concept of entropy.

UNIT IV**5. Steam Generators**

Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction and working of Nestler boiler, Babcock & Wilcox Boiler. function of various boiler mounting and accessories, Introduction to modern boilers – Benson boiler.

6. Properties of Steam

Formation of steam and related terms, thermodynamic properties of steam, steam tables, sensible heat, latent heat, internal energy of steam, entropy of water, entropy of steam, T- S diagrams, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes, determination of quality of steam (dryness fraction),

UNIT V**7. Ideal and Real Gases**

Concept of ideal gas, enthalpy and specific heat capacities of an ideal gas, P – V – T surface of an ideal gas, triple point, real gases, Vander-Wall's equation

8. Air Compressors

Functions of air compressor – uses of compressed air, type of air compressors

Single stage reciprocating air compressor, its construction and working, representation of processes involved on P – V diagram, calculation of work done.

Multistage compressors – advantages over single stage compressors, use of air cooler, condition of minimum work in two stage compressor (without proof).

Rotary compressors – types, working and construction of centrifugal compressor, axial flow compressor, vane type compressor

PRACTICAL EXERCISES

1. Determination of temperature by
 - 1.1 Thermocouple
 - 1.2 Pyrometer
 - 1.3 Infrared thermometer
2. Study the working of Nestler boiler.
3. Study of working of high pressure boiler.
4. Demonstration of mountings and accessories on a boiler.
5. Determination of dryness fraction of steam using calorimeter.
6. Demonstrate the working of air compressor.

Note : Industrial visit may be planned to show working of boilers.

RECOMMENDED BOOKS

1. PK Nag, “Engineering Thermodynamics”, Tata McGraw Hill, Delhi.
2. Roy Chaudhary, “Basic Engineering Thermodynamics”, Tata McGraw Hill, Delhi.
3. CP Arora, “Engineering Thermodynamics”, Tata McGraw Hill, Delhi.
4. VP Vasandani and DS Kumar, “A Treatise on Heat Engineering”, Metropolitan Book Company.

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.

3.5 WORKSHOP TECHNOLOGY-II

L P
3 -

RATIOANLE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various manufacturing processes is required to be imparted. Hence the subject of workshop technology.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

- CO1: Demonstrate applications of various welding processes.
- CO2: Explain the process of pattern making, moulding and casting
- CO3: Explain procedure of various types of NDT for welding and casting.
- CO4: Explain the working of various machining processes such as shaping, planning, milling and broaching
- CO5: Understand functions and operations of various jigs and fixtures.

DETAILED CONTENTS

UNIT I

1. Welding

Resistance welding: Principle, advantages, limitations, working and applications of spot welding and seam welding

Other Welding Processes: Principle, advantages, limitations, working and applications of Shielded metal arc welding, submerged arc welding. Welding defects, methods of controlling welding defects and inspection of welded joints.

Modern Welding Methods: Methods, Principle of operation, advantages, disadvantages and applications of, Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding, Robotic welding

UNIT II

2. Foundry Techniques

2.1. Pattern Making

Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S., Introduction to cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores

2.2. Moulding and Casting

Moulding Sand: Properties of moulding sand, their impact and control of properties viz. permeability, refractoriness, adhesiveness, cohesiveness, strength, flowability, collapsibility, Various types of moulding sand, Testing of moulding sand.

Mould Making: Types of moulds, Step involved in making a mould, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floor molding, pit molding and machine molding.

Casting Processes: Charging a furnace, melting and pouring both ferrous and non ferrous metals, cleaning of castings, Principle, working and applications of Die casting: hot chamber and cold chamber, Centrifugal casting

Gating and Riser System: Elements of gating system, Pouring basin, sprue, runner, gates, Types of risers, location of risers, Directional solidification.

Melting Furnaces: Construction and working of Pit furnace, Cupola furnace, Crucible furnace – tilting type, Electric furnace

Casting Defects: Different types of casting defects, Non destructive testing (NDT) of castings: die penetration test, radiography, magnetic particle inspection and ultrasonic inspection.

UNIT III

3. Shaping, Slotting and Planing

3.1 Working principle and construction of shaper, slotter and planer

3.2 Type of shapers and slotters

3.3 Type of planers

3.4 Quick return mechanism applied to shaper and planer machine.

3.5 Work holding devices used on shaper and planer

3.6 Types of tools used and their geometry.

3.7 Specification of shaper and planer.

3.8 Speeds and feeds in above processes.

4 Broaching

4.1 Introduction to broaching

4.2 Nomenclature of broach tools, types and material

4.3 Types of broaching machines – single ram and duplex ram horizontal type, vertical type pull up, pull down and push down.

UNIT IV

5. Milling

5.1 Milling methods - up milling and down milling

5.2 Specification and working principle of milling machine

5.2 Classification, brief description and applications of milling machines

5.3 Details of column and knee type milling machine

5.4 Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment, rotary table.

5.5 Identification of different milling cutters and work mandrels

5.7 Work holding devices

5.8 Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.

5.9 Cutting parameters

UNIT V

6 Jigs and Fixtures

6.1 Importance and use of jigs and fixtures, difference between jig and fixture.

6.2 Principal of location

6.3 Locating and clamping devices

6.4 Types of jigs – drilling jig, template jig and plate jig

6.5 Types of fixtures – Milling and welding fixture

RECOMMENDED BOOKS

1. BS Raghuvanshi, “Workshop Technology”, Dhanpat Rai and Sons Delhi.
2. SK Choudhry and Hajra, “Elements of Workshop Technology”, Asia Publishing House.
3. RL Aggarwal and T Manghnani, “Welding Engineering”, Khanna Publishers, Delhi.
4. PC Sharma, “A Text Book of Production Engineering”, S Chand and Company Ltd. Delhi.

5. PN Rao, “Manufacturing Technology, Vol I and II”, Tata McGraw Hill, Delhi.
6. KP Sinha and DB Goel, “Foundry Technology”, Roorkee Publishing House, Roorkee.

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.

3.6 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L P
2 -

RATIONALE

The objective of this course is to impart fundamental knowledge and skills regarding basic electrical and electronics engineering, which diploma holders will come across in their professional life. This course will provide the students to understand the basic concepts and principles of a.c. fundamentals, electromagnetic induction, transformers, motors, distribution system, domestic installation, electrical safety etc. The students will also learn basic electronics along with their applications.

COURSE OUTCOMES:

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

- CO1: Interpret various electrical quantities.
- CO2: Improve power factor in a given circuit.
- CO3: Explain construction, working principle, and applications of transformer.
- CO4: Identify different wires of distribution system.
- CO5: Describe the working of single phase and three phase motors.
- CO6: Follow electrical safety measures.
- CO7: List the applications of diodes and ICs.

DETAILED CONTENTS

UNIT I

1. Basic Electrical Quantities

Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities, connection of these instruments in an electric circuit. Difference between ac and dc. Various applications of electricity.

2. AC Fundamentals

Electromagnetic induction-Faraday's Laws, Lenz's Law; Fleming's rules, Principles of a.c. Circuits; Alternating emf, Definition of cycle, frequency, amplitude and time period. Concept of electrical power, Concept of phase and phase difference. Concept of resistance, inductance and capacitance in simple a.c. circuit. Concept of three phase system; star and delta connections; voltage and current relationship (no derivation)

UNIT II

3. Transformer

Working principle and construction of single phase transformer, transformer ratio, emf equation, tapping of transformer, power transformer, auto transformer and distribution transformer (brief idea and difference between them), cooling of transformer, applications of various types of transformers.

4. Distribution System

Difference between high and low voltage distribution system, identification of three-phase wires, neutral wire and earth wire in a low voltage distribution system. Identification of voltages between phases and between one phase and neutral. Difference between three-phase and single-phase supply

UNIT III

5. Electric Motor

Description and applications of single-phase and three-phase motors. Introduction to DC motor and its applications, Difference between ac and dc motor, Connection and starting of three-phase induction motors by DOL and star-delta starter. Changing direction of rotation of a given 3 phase induction motor. Motors used for driving pump, compressor and e vehicles.

UNIT IV

6. Domestic Installation

Distinction between light-fan circuit and single phase power circuit, sub-circuits, various accessories and parts of domestic electrical installation. Different types of wires and their IS specification, Identification of wiring systems. Colour coding of electrical wires.

7. Electrical Safety

Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, concept of earthing and various types of earthing, brief description of range of protective devices like MCB, ELCB, and RCB

UNIT V

8. Basic Electronics

Concept of semi conductor, types- P and N type. Diodes and their applications, Transistor – PNP and NPN. Their characteristics and uses. Introduction to integrated circuit (IC), Different types of ICs used in electric drives and their control circuit.

RECOMMENDED BOOKS

1. P.S. Dhogal, “Basic Electrical Engineering”, Tata McGraw Hill Publishers, New Delhi.
2. B. L. Thareja, “A Text Book of Electrical Technology Vol. I and II”, S Chand and Co., New Delhi.
3. J. B. Gupta, “Basic Electrical Engineering”, S. Kataria and Sons, Delhi.
4. N.N. Bhargava and Kulshreshta, “Basic Electronics and Linear Circuits”, Tata McGraw Hill, New Delhi.
5. S. K. Sahdev, “Electronic Principles”, Dhanpat Rai and Sons, New Delhi.
6. V. K. Mehta, “Principles of Electrical and Electronics Engineering”, S. Chand and Company Ltd.. New Delhi.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of concept and various terms used in the subject. This is theoretical subject and contains five units of equal weight age.

3.7 WORKSHOP PRACTICE - II

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 the subject, the students will be able to:

CO1: Prepare jobs on lathe, shaper, planer and milling machines.

C02: Carry out welding of parts.

C03: Carry out pattern making, moulding and casting operations.

PRACTICAL EXERCISES

Advance Turning Shop

1. Exercise of boring with the help of boring bar
2. Exercises on internal threading on lathe machine
3. Preparing a composite job involving turning, taper turning, external thread cutting and knurling.
4. Eccentric turning job on a lathe using 4-Jaw chuck.
5. Resharpening of single point cutting tool with given geometry

Machine Shop

- 1 Prepare a V-Block up to ± 0.5 mm accuracy on shaper machine
- 2 Exercise on key way cutting and spline cutting on shaper machine.
- 3 Produce a rectangular slot on one face with a slotting cutter
- 4 Produce a rectangular face using a planer machine
- 5 Produce a rectangular block using a milling machine with a side and face cutter
- 6 Exercise on milling machine to produce a spur gear

Advance Welding Shop

- 1 Practice of electric arc welding/MIG/TIG welding on welding Simulator
- 2 Exercise on spot welding/seam welding (any utility item)
- 3 Prepare a lap joint on MIG welding
- 4 Prepare a butt joint on TIG welding
- 5 Exercise on Pipe/MS-Plate cutting by chop-saw & disk grinder.
- 6 Job on laser welding machine

Pattern Making

1. Preparation of solid/single piece pattern.
2. Preparation of two piece/split pattern
3. Preparation of a pattern on wooden lathe
4. Preparation of a self cored pattern
5. Preparation of a core box.

Foundry Shop

1. Preparation of mould with solid pattern on floor.
2. Preparation of floor mould of solid pattern using cope.
3. Preparation of floor mould of split pattern in cope and drag of moulding box.
4. Moulding and casting of a solid pattern of aluminum
5. Preparing a mould of step pulley and also preparing core for the same.
6. Testing of moisture contents and strength of moulding sand.

RECOMMENDED BOOKS

- 1 BS Raghuvanshi, “Workshop Technology”, Dhanpat Rai and Sons, Delhi.
- 2 SK Choudhry and Hajra, “Elements of Workshop Technology”, Asia Publishing House.
- 3 RL Aggarwal and T Manghnani, “Welding Engineering”, Khanna Publishers, Delhi.
- 4 PC Sharma, “A Text Book of Production Engineering”, S Chand and Company Ltd., Delhi.
- 5 KP Sinha and DB Goel, “Foundry Technology”, Roorkee Publishing House, Roorkee.

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students.

3.8 OPEN ELECTIVE

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RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the different streams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

- CO1: State the basic concepts and principles about the subject of interest.
- CO2: Perform in a better way in the professional world.
- CO3: Select and learn the subject related to own interest.
- CO4: Explore latest developments in the field of interest.
- CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System
8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations
13. Digital Marketing

14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered either in online or offline mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline open electives, a suitable relevant subject shall be offered by the respective department to the students as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

Assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests, assignments etc. and external assessment of 60 marks shall be based on external examination.

SUGGESTED WEBSITES

1. <https://swayam.gov.in/>

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

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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 weightage.

4.2 MATERIALS AND METALLURGY

L P
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

L 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 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

L P
3 -

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

L	P
3	2

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. Subramaniam 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.

