

**CURRICULUM**

for

**DIPLOMA PROGRAMME**

in

**MECHANICAL ENGINEERING**

3<sup>rd</sup> Year (5<sup>th</sup> & 6<sup>th</sup> Semester)

**FOR THE STATE OF HIMACHAL PRADESH**



June, 2019

## Study & Evaluation Scheme

### 5<sup>th</sup> SEMESTER (MECHANICAL ENGINEERING)

S. No.	SUBJECTS	STUDY SCHEME Hrs/Week		EVALUATION SCHEME								Total Marks
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
5.1	Basics of Management & Entrepreneurship Development*	4	-	50	-	<b>50</b>	100	3	-	-	100	150
5.2	Thermal Engineering-II	4	2	30	20	<b>50</b>	100	3	50	3	150	200
5.3	Machine Design	5	-	50	-	<b>50</b>	100	3	-	-	100	150
5.4	Manufacturing Technology-III	<b>3</b>	6	30	50	<b>80</b>	100	3	70	3	170	250
5.5	Elective 5.5.1 Foundry Technology 5.5.2 Welding Technology 5.5.3 Tool Engineering 5.5.4 **Mechatronics 5.5.5 Power Plant Engineering	4	2	30	20	<b>50</b>	100	3	50	3	150	200
5.6	Minor Project	-	<b>6</b>	-	50	<b>50</b>	-	-	50	3	50	100
5.7	Practices In Communication Skills*	-	2	-	50	<b>50</b>	-	-	50	3	50	100
Students Centered Activities		-	2	-	25	<b>25</b>	-	-	-	-	-	25
Industrial training		-	-	-	50	<b>50</b>	-	-	50	-	50	100
<b>Total</b>		<b>20</b>	<b>20</b>	<b>190</b>	<b>215</b>	<b>455</b>	<b>500</b>	-	<b>320</b>	-	<b>820</b>	<b>1275</b>

\*Common with other diploma programmes

\*\* Common with Diploma in Automobile Engineering

**Note:** Apart from the above mentioned number of hours for each subject (Theory & Practical), at least **TWO** hours/week for each class should be allocated for Library to motivate the students to attend library compulsory. The attendance of library period should be added in master attendance.

## Study & Evaluation Scheme

### 6<sup>th</sup> SEMESTER (MECHANICAL ENGINEERING)

S. No.	SUBJECTS	STUDY SCHEME		EVALUATION SCHEME								Total Marks
		Hrs/Week		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
6.1	Production Planning and Control	4	-	50	-	50	100	3	-	-	100	150
6.2	Refrigeration and Air Conditioning	4	2	30	20	50	100	3	50	3	150	200
6.3	Automobile Engineering	4	2	30	20	50	100	3	50	3	150	200
6.4	Computer Aided Drafting	-	4	-	50	50	-	-	100	3	100	150
6.5	CNC Machine and Automation	4	4	30	20	50	100	3	50	3	150	200
6.6	# Automation Lab	-	2	-	50	50	-	-	50	3	50	100
6.7	Major Project	-	8	-	100	100	-	-	100	3	100	200
Student Centered Activities		-	2	-	25	25	-	-	-	-	-	25
<b>Total</b>		<b>16</b>	<b>24</b>	<b>140</b>	<b>285</b>	<b>425</b>	<b>400</b>	<b>-</b>	<b>400</b>	<b>-</b>	<b>800</b>	<b>1225</b>

# The automation lab can be shared with Electrical Engineering/ Electronics Engineering wherever possible.

**Note:** Apart from the above mentioned number of hours for each subject (Theory & Practical), at least **TWO** hours/week for each class should be allocated for Library to motivate the students to attend library compulsory. The attendance of library period should be added in master attendance.

## 5.1 BASICS OF MANAGEMENT & ENTREPRENEURSHIP DEVELOPMENT

L T P

4 - -

### RATIONALE

*In present scenario, there is an urgent need to develop right kind of attitude, knowledge and skills amongst the Diploma engineers leading them to achieve gainful wage/ self-employment. There is a huge gap in perceptions of employers and employees regarding meeting the job requirements. Also the dual challenges of competing in global working environment and keeping pace with the rapid technological advancements call for re-design of curricula and thus enabling the importance of generic and managerial skills. Entrepreneurship development aim at developing conceptual understanding for setting up owns' business/enterprise to cope up with the problem of unemployment and also to promote the socio- economic development of our country. Both the subject areas, "Basics of Management and entrepreneurship development" are supplementary to each other. Knowledge and skills of these must be imparted to diploma engineering students for enhancing their employability and confidence in their personal and professional life.*

### DETAILED CONTENTS

- 1. Introduction to Management (7 hrs)**
  - 1.1 Definitions and concept of Management
  - 1.2 Functions of management- planning, organizing, staffing, coordinating and controlling.
  - 1.3 Various areas of management
  - 1.4 Structure of an Organization
  
- 2. Self-Management and Development (10 hrs)**
  - 2.1 Life Long Learning Skills, Concept of Personality Development, Ethics and Moral values
  - 2.2 Concept of Physical Development; Significance of health, hygiene, body gestures
  - 2.3 Time Management Concept and its importance
  - 2.4 Intellectual Development: Reading skills, speaking, listening skills, writing skills (Note taking, rough draft, revision, editing and final drafting), Concept of Critical Thinking and Problem Solving (approaches, steps and cases).
  - 2.5 Psychological Management: stress, emotions, anxiety and techniques to manage these.
  - 2.6 ICT & Presentation skills; use of IT tools for good and impressive presentations.
  
- 3. Team Management (10 hrs)**
  - 3.1 Concept of Team Dynamics. Team related skills, managing cultural, social and ethnic diversity in a team.
  - 3.2 Effective group communication and conversations.
  - 3.3 Team building and its various stages like forming, storming, norming, performing and adjourning
  - 3.4 Leadership, Qualities of a good leader
  - 3.5 Motivation, Need of Motivation, Maslow's theory of Motivation
  
- 4. Project Management (5 hrs)**
  - 4.1 Stages of Project Management; initiation, planning, execution, closing and review (through case studies), SWOT analysis concept.

- 5. Introduction to Entrepreneurship (10 hrs)**
- 5.1 Entrepreneurship, Need of entrepreneurship, and its concept, Qualities of a good entrepreneur
  - 5.2 Business ownerships and its features; sole proprietorship, partnership, joint stock companies, cooperative, private limited, public limited, PPP mode.
  - 5.3 Types of industries: micro, small, medium and large
- 6. Entrepreneurial Support System (Features and Roles in Brief) (7 hrs)**
- 6.1 District Industry Centers (DICs), State Financial Corporations (SFCs), NABARD,
  - 6.2 MSME (Micro, Small, Medium Enterprises) – its objectives & list of schemes
- 7. Market Study and Opportunity Identification (7 hrs)**
- Types of market study: primary and secondary, product or service identification, assessment of demand and supply, types of survey and their important features
- 8. Project Report Preparation (8 hrs)**
- 8.1 Preliminary Report, Techno-Economic Feasibility Report, Detailed Project Report (DPR).

### **LIST OF TUTORIAL EXERCISES**

1. Understanding Self-Management and Development (Related to Chapter 02); through examples, cases, exercises, panel discussions, seminars, meditation and yoga techniques.
2. SWOT Analysis
3. Team Management (Related to chapter 03); through examples, cases, role plays, group discussions and panel discussions.
4. Market Study and Opportunity Identification (Related to Chapter 07); through literature reviewing, making questionnaires, conducting mock interviews and analyzing data for product/service identification and demand assessment.
5. Project Management and Project Report Preparation through exercises on making project reports on micro and small enterprises. Case studies and SWOT analysis of projects can be taken.

### **RECOMMENDED BOOKS**

1. Generic Skill Development Manual, MSBTE, Mumbai
2. Lifelong Learning, Policy Brief(www.oecd.org)
3. Towards Knowledge Society, UNESCO Publication, Paris
4. Entrepreneurship Development by CB Gupta and P Srinivasan: Sultan Chand and sons: New Delhi
5. Essentials of Management by H Koontz, C O' Daniel , McGraw Hill
6. Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi
7. Management by James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr., Prentice Hall of India Pvt. Ltd, New Delhi
8. Entrepreneurship Development by S. L. Gupta and Arun Mittal: IBH Publication

9. A Handbook of Entrepreneurship, Edited by B S Rathore and Dr. J S Saini
10. Entrepreneurship Development and Small Business Enterprises by Poornima M:  
Pearson Education India
11. Handbook of Small Scale Industry by P M Bhandari

#### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs.)</b>	<b>Marks Allotted (%)</b>
1	07	10
2	10	15
3	10	15
4	05	10
5	10	15
6	07	10
7	07	10
8	08	15
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.2 THERMAL ENGINEERING– II

L T P  
4 - 2

### RATIONALE

*Thermal energy is a major means of power in the world. Knowledge of thermal contrivances and related principles is very essential to the students of Mechanical Engineering. The subject presents sources of heat, thermodynamics principles and their applications to thermal contrivances.*

### DETAILED CONTENTS

- 1. Power Cycles (10 hrs)**
  - 1.1 Concept of reversibility, Carnot cycle
  - 1.2 Rankine cycle and its efficiency
  - 1.3 Brayton cycle
  - 1.4 Otto, Diesel and Dual Combustion cycle
  
- 2. Principles of I.C. Engines (10 hrs)**
  - 2.1 Introduction and classification of I.C. Engines
  - 2.2 Working principle of two strokes and four strokes cycle by representing on PV and valve timing diagrams
  - 2.3 Petrol and diesel engines, their comparison and applications
  - 2.4 Location and functions of various parts of I.C. engines and materials used for them
  - 2.5 Concept of IC engine terms: Bore, stroke, dead centres, crank throw, compression ratio, clearance volume, piston displacement and piston speed. Familiarity with ISI specification for I.C. engine parts
  
- 3. Carburation and Ignition Systems of Petrol Engine (08 hrs)**
  - 3.1 Concept of carburetion
  - 3.2 Air fuel ratio
  - 3.3 Simple carburettor and its limitations
  - 3.4 Description of a battery coil and magneto ignitions system
  
- 4. Fuel System in Diesel Engines (08 hrs)**
  - 4.1 Components of Fuel system
  - 4.2 Description and working of fuel feed pump
  - 4.3 Fuel injection pump
  - 4.4 Injector
  - 4.5 Multi Point Fuel Injection Systems
  
- 5. Cooling and Lubrication (06 hrs)**
  - 5.1 Necessity of Engine Cooling
  - 5.2 Cooling systems: their main features
  - 5.3 Thermostat

- 5.4 Defects in cooling system and their rectification
- 5.5 Function of lubrication
- 5.6 Types and properties of Engine lubricants
- 5.7 Lubrication systems of I.C. engine
- 5.8 ISI specification and brand names of Engine lubricants
- 5.9 Fault in cooling and lubrication system and their remedial actions

## **6. I.C. Engine Testing**

**(14 hrs)**

- 6.1 Engine power - indicated and Brake power
- 6.2 Efficiency - Mechanical, Thermal, Relative and volumetric
- 6.3 Methods of finding indicated and brake power
- 6.4 Morse Test
- 6.5 Heat balance sheet

## **7. Air Compressors**

**(08 hrs)**

- 7.1 Industrial uses of compressed air
- 7.2 Classification - description of reciprocating and Rotary air compressors
- 7.3 Fans, Blowers and supercharger 34
- 7.4 Working principle of reciprocating single and two stage compressors
- 7.5 Intercooling, volumetric efficiency
- 7.6 Operation and Maintenance of reciprocating compressors

## **LIST OF PRACTICALS**

1. Study the function and material of each part of two stroke engine
2. Study the function and material of each part of diesel engine
3. Study of MPFI system
4. Study of battery ignition system of a multi-cylinder petrol engine, setting of ignition timings, firing order and contact breaker gap
5. Study of cooling system of I.C. Engine and find the fault in the cooling system
6. Study of lubricating system of I.C. engine
7. Determination of BHP by dynamometer and heat balance sheet
8. Morse test on multi-cylinder petrol engine and heat balance sheet
9. Study the working of air compressor

## **RECOMMENDED BOOKS**

1. Elements of Heat Engine by Pandey and Shah, Charotar Publishing Home
2. Thermal Engineering by A.S. Sarao, SatyaPrakashan
3. Thermal Engineering by P.L. BallaneyKhanna Publisher
4. Thermal Engineering by R.K. Prohit, Standard Publisher
5. Thermal Engineering by PK Nag



### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	10	15
2	10	20
3	08	10
4	08	10
5	06	15
6	14	15
7	08	15
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.3 MACHINE DESIGN

L T P  
5 - -

### RATIONALE

*A diploma holder in Mechanical Engineering 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. Hence this subject. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.*

- Note:** a) Use of design data book during the examination is allowed.  
b) The paper setter should provide all the relevant data for the machine design Numerical in the question paper.

### DETAILED CONTENTS

#### 1. Introduction (08 hrs)

- 1.1 Design – Definition, Type of design, necessity of design
  - 1.1.1 Comparison of designed and un-designed work
  - 1.1.2 Design procedure
  - 1.1.3 Characteristics of a good designer
- 1.2 Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.
  - 1.2.1 General design consideration
  - 1.2.2. Codes and Standards (BIS standards)
- 1.3 Engineering materials and their mechanical properties
  - 1.3.1 Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity, strength
  - 1.3.2 Selection of materials, criterion for material selection

#### 2. Design Failure (08 hrs)

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

#### 3. Design of Shafts (12 hrs)

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

#### **4. Design of Keys** **(06 hrs)**

- 4.1 Types of keys, materials of keys, functions of keys
- 4.2 Failure of keys (by Shearing and Crushing)
- 4.3 Design of keys (Determination of key dimension)
- 4.4 Effect of keyways on shaft strength

#### **5. Design of Joints** **(24 hrs)**

Types of joints - Temporary and permanent joints, utility of various joints

##### 5.1 Temporary Joint

- 5.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint
- 5.1.2 Cotter Joint – Different parts of the spigot and socket joints, Design of spigot and socket joint

##### 5.2 Permanent Joint

- 5.2.1 Welded Joint - Welding symbols. Type of welded joint, strength of parallel and transverse fillet welds
- 5.2.2 Strength of combined parallel and transverse weld
- 5.2.3 Riveted Joints: Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering
- 5.2.4 Different modes of rivet joint failure
- 5.2.5 Design of riveted joint – Lap and butt, single and multi-riveted joint

#### **6. Design of Flange Coupling** **(08 hrs)**

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).

#### **7. Design of Screwed Joints** **(14 hrs)**

- 7.1 Introduction, Advantages and Disadvantages of screw joints, location of screw joints
- 7.2 Important terms used in screw threads, designation of screw threads
- 7.3 Initial stresses due to screw up forces, stresses due to combined forces
- 7.4 Design of bolts for cylinder cover

#### **RECOMMENDED BOOKS**

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

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	08	12
2	08	06
3	12	16
4	06	10
5	24	32
6	08	12
7	14	12
<b>Total</b>	<b>80</b>	<b>100</b>

## 5.4 MANUFACTURING TECHNOLOGY-III

L T P

3 - 6

### RATIONALE

*This subject aims at development of knowledge and skills regarding various production processes like milling, press tools, broaching, gear cutting and advanced welding techniques. Diploma holders are required to handle these machines and equipments. Hence this subject is required and is in continuation with Manufacturing Processes-II.*

### DETAILED CONTENTS

1. **Milling** (13 hrs)
  - 1.1 Introduction to milling
  - 1.2 Types of milling machines
  - 1.3 Constructional features of Knee and Column type milling machine
  - 1.4 Specifications of milling machine
  - 1.5 Milling operations- plain, angular, form, straddle and gang milling
  - 1.6 Milling cutters - Geometry and types
  - 1.7 Cutting speed and feeds
  - 1.8 Indexing-simple, compound, differential and angular
  - 1.9 Job holding devices
  - 1.10 Introduction to machining centre
  
2. **Presses and Press Tools** (8 hrs)
  - 2.1 Types of Presses, their applications
  - 2.2 Types of dies
  - 2.3 Types of die sets
  - 2.4 Punches
  - 2.5 Pads
  - 2.6 Die clearance
  - 2.7 Stripper plates
  - 2.8 Stops
  - 2.9 Pilots
  - 2.10 Stock Layout
  
3. **Broaching** (06 hrs)
  - 3.1 Introduction
  - 3.2 Types of broaching machines
  - 3.3 Types of broaches and their use
  
4. **Metal Coating Processes** (04 hrs)
  - 4.1 Metal spraying
  - 4.2 Galvanizing
  - 4.3 Electroplating
  - 4.4 Anodizing
  
5. **Gear Generating and Finishing Processes** (06 hrs)
  - 5.1 Gear tooth elements
  - 5.2 Gear milling
  - 5.3 Introduction to gear shaping

- 5.4 Working principle of gear shaping machine  
Working principle of gear hobbing
- 5.5 machine
- 5.6 Introduction to gear finishing operations

**6. Advanced Welding Techniques (11 hrs)**

- 6.1 Working principle, process details, equipment details, advantages, limitations and applications of:
- 6.2 Thermit Welding
- 6.3 MIG Welding
- 6.4 TIG Welding
- 6.5 Atomic hydrogen Welding
- 6.6 Electron beam welding
- 6.7 Laser beam welding
- 6.8 Introduction to friction welding

**LIST OF PRACTICALS**

1. Job on producing a rectangular block by milling to a given accuracy of 0.1 mm to 0.02 mm.
2. To prepare a slot on one face of a job with a slotting cutter/ side and face milling cutter on job number 1.
3. Use of form milling cutter to make a contour on job-2.
4. Exercise on different types of indexing (simple, compound, angular and differential & job only simple/differential).
5. Cutting spur gear on milling machine.
6. Introduction to preventive maintenance/ lubrication/ inspection of lathe machine.
7. Practice on sharpening of single point cutting tool used on lathe (V-shape, side, left hand, right hand, forging tool and boring tool).
8. Exercise on lathe with accuracy of 0.02mm by using knurling, parting, threading operations.
9. Making a job on right, left, boring and forging tool by using high carbon steel (job will be transferred to turning shop).
10. Making a square / hexagonal headed bolt by drop forging.
11. Fabrication of circular job using TIG welding.
12. Fabrication of a butt/ lap joint using MIG welding.
13. Practice of vertical/ overhead welding.
14. Trouble shooting of electrical and electronics faults with their remedial majors in machines.

**RECOMMENDED BOOKS**

1. Elements of workshop technology by SK Chaudhry and Hajra, Asia Publishing House
2. Workshop Technology Vol I, II & III by Chapman; Standard Publishers
3. Production Technology by HMT, Tata McGraw Publishers, New Delhi

**SUGGESTED DISTRIBUTION OF MARKS**

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1	13	25
2	08	15
3	06	15
4	04	10
5	06	15
6	11	20
<b>Total</b>	<b>48</b>	<b>100</b>

## 5.5.1 FOUNDRY TECHNOLOGY

L T P

4 - 2

### RATIONALE

*Foundry Technology deals with the process of making castings in moulds of sand or other materials. A Diploma holder Mechanical Engineering is required to supervise production. For this, knowledge about foundry practices be imparted' to him. This subject aims at development knowledge and skills in the area of various case processes and developments in this area.*

### DETAILED CONTENTS

- 1. Pattern Making (6 hrs)**
  - 1.1 Materials for pattern making
  - 1.2 Factors affecting selection
  - 1.3 Jointing materials for pattern construction
  - 1.4 Finishing the patterns
  - 1.5 Pattern fillets
  - 1.6 Pattern allowances
  - 1.7 Types of patterns
  - 1.8 Tools used for making pattern
  - 1.9 Core prints and core boxes
  - 1.10 Preparation of pattern and core box
  - 1.11 Machines used in pattern making
  - 1.12 Defects caused by pattern design
  
- 2 Moulding And Core Making (6 hrs)**
  - 2.1 Moulding sands
  - 2.2 Principle ingredients of moulding sand
  - 2.3 Specification and testing of moulding sand
  - 2.4 Sand preparation
  - 2.5 Moulding processes - Bench floor moulding, pit moulding
  - 2.6 Hand moulding
  - 2.7 Machine Moulding
  - 2.8 Core sands
  - 2.9 Types of cores
  - 2.10 Core making
  - 2.11 Gates and risers
  - 2.12 Defects making caused by moulding and core making
  
- 3 Mould Drying And Core Making (4 hrs)**
  - 3.1 Mould, drying
  - 3.2 Core Drying
  - 3.3 Defects
  
- 4 Melting Practice (8 hrs)**
  - 4.1 Types of furnaces- are, open hearth, air
  - 4.2 Melting of Aluminium and its alloys
  - 4.3 Melting of Copper and its alloys
  - 4.4 Steel melting practice
  - 4.5 Melting practice for cast iron

- 5 Closing And Pouring The Moulds** (4 hrs)
- 5.1 Coring up, venting and closing
  - 5.2 Ladles, pouring
- 6 Solidification Of Casting** (8 hrs)
- 6.1 Nucleation
  - 6.2 Growth
  - 6.3 Directional solidification
  - 6.4 Pouring rate and temperature
  - 6.5 Padding
  - 6.6 use of chills
- 7 Casting Processes** (8 hrs)
- 7.1 Sand casting
  - 7.2 Permanent mould casting
  - 7.3 Slush casting
  - 7.4 Die casting
  - 7.5 Plaster mould casting
  - 7.6 Shell moulding
  - 7.7 Investment casting
  - 7.8 Centrifugal Moulding
  - 7.9 Carbon dioxide moulding
  - 7.10 Continuous casting
- 8 Cleaning And Inspection Of Casting** (8 hrs)
- 8.1 Shaking of moulds
  - 8.2 Removal of dry sand cores
  - 8.3 Removal of extra parts
  - 8.4 Cleaning of casting
    - 8.4.1 Chipping, burning off and grinding
    - 8.4.2 Rumbling, shot blasting and hydro blast
    - 8.4.3 surface treatment
  - 8.5 Inspection of casting
- 9 Heat Treatment Of Casting** (4 hrs)
- 9.1 Stress relief and annealing
  - 9.2 Treatments involving rapid cooling
  - 9.3 Defects caused by heat treatment
- 10 Modernization Of Foundries** (8 hrs)
- 10.1 Foundry mechanization
  - 10.2 Elements of mechanization
  - 10.3 Sand preparation units
  - 10.4 Equipment for dust and fume control
  - 10.5 Equipment for moulding and core making
  - 10.6 Melting, pouring and shake out units



**Note:**

- *An expert from industry may be invited from some industry.*
- *Industrial visit may be arranged.*

**LIST OF PRACTICALS**

1. Making at least two patterns out of the following:
  - 1.1 Solid one piece pattern
  - 1.2 Split two piece pattern
  - 1.3 Split three piece pattern
  - 1.4 Gated pattern
  
- 2 Making at least two core boxes out of the following:
  - 2.1 Straight core box
  - 2.2 Bent core box
  - 2.3 Unbalanced core
  
3. To find out the moisture content, clay and permeability of moulding-sand.
4. To prepare sand moulds of different forms with different types of pattern using floor moulding, two box moulding and three box moulding.
5. Making and setting of cores of different types.
6. Melting of cast iron in Cupola and pouring in mould.
7. Melting of non ferrous metal in a pit furnace and pouring the mould.
8. Shaking, cleaning and fettling of castings.
9. Inspection and testing of casting and to find out the causes of weld defects.

**RECOMMENDED BOOKS**

1. A Text-Book of Foundry Technology by O.P. Khanna
2. Foundry Technology by K.P. Sinha & D.B. Goel
3. Principles of Foundry Technology by P.L. Jain

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	06	10
2	06	10
3	04	08
4	08	10
5	04	08
6	08	12
7	08	10
8	08	12
9	04	08
10	08	12
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.5.2 WELDING TECHNOLOGY

L T P

4 - 2

### RATIONALE

*Welding Processes are extensively used in industries for production as well as repair and maintenance areas. A diploma holder in Mechanical, Engg.is required to look after fabrication and repair and maintenance operations. For this knowledge and skills in the area of welding technology is required to be imparted to them. Therefore, this subject aims at development of knowledge and skills in the area of welding techniques, both conventional and modern.*

### DETAILED CONTENTS

- 1. Introduction To Welding** **(6 hrs)**
  - 1.1 Principle of welding
  - 1.2 Classification of welding processes
  - 1.3 Advantages, Limitations of welding.
  - 1.4 Welding applications
  - 1.5 Weld ability
  
- 2 Gas Welding** **(8 hrs)**
  - 2.1 Principle of operation
  - 2.2 Oxyacetylene flame
    - 2.2.1 Types of flame
    - 2.2.2 Combustion of flame
  - 2.3 Welding Techniques
  - 2.4 Filler rods And fluxes for gas welding
  - 2.5 Gas welding equipment and accessories
    - 2.5.1 Oxygen gas cylinders
    - 2.5.2 Acetylene gas cylinders
    - 2.5.3 Acetylene gas generator
    - 2.5.4 Pressure Regulator
    - 2.5.5 Oxygen and Acetylene Hoses
    - 2.5.6 Welding Torch
  
- 3 Arc Welding** **(8 hrs)**
  - 3.1 Arc welding process
  - 3.2 Striking the arc
  - 3.3 Arc length
  - 3.4 Arc blow
  - 3.5 Arc welding machines- types and details
  - 3.6 Selection of welding machines
  - 3.7 AC and DC welding and effects of polarity
  - 3.8 Electrodes-classification, specifications and selection
  - 3.9 Coated electrodes
  - 3.10 Welding positions
  - 3.11 Welding procedures
  - 3.12 Welding defects

- 4 **Resistance Welding** (8 hrs)
  - 4.1 Principle
  - 4.2 Advantages, disadvantages
  - 4.3 Applications
  - 4.4 Spot welding
  - 4.5 Seam welding
  - 4.6 Projection welding
  - 4.7 Butt Welding
    - 4.7.1 Upset butt welding
    - 4.7.2 Flash butt welding
  - 4.8 Percussion welding
  
- 5 **Other Welding Processes** (10 hrs)
  - 5.1 Submerged arc welding
  - 5.2 TIG welding
  - 5.3 MIG welding
  - 5.4 Electro slag welding
  - 5.5 Plasma arc welding
  - 5.6 Ultrasonic welding
  - 5.7 Thermit welding
  - 5.8 Atomic hydrogen welding
  - 5.9 Electron beam welding
  - 5.10 Laser beam welding
  - 5.11 Automated welding
  
- 6 **Brazing** (6 hrs)
  - 6.1 Principle
  - 6.2 Procedure
  - 6.3 Brazing filler alloys
  - 6.4 Brazing fluxes
  - 6.5 Advantages, Limitations and applications
  
- 7 **Soldering** (6 hrs)
  - 7.1 Principle
  - 7.2 Solders
  - 7.3 Soldering fluxes
  - 7.4 Soldering Methods
  - 7.5 PCB Soldering
  
- 8 **Welding Of Different Materials** (6 hrs)
  - 8.1 Welding Cast iron, Alloy Steel, tool Steel, Aluminium, Magnesium, Stainless, Copper
  
- 9 **Weld Defects And Testing** (6 hrs)
  - 9.1 Types of weld Defects; their causes and prevention.
  - 9.2 Destructive testing of welds
  - 9.3 Non Destructive tests- Fluorescent penetration test, magnetic particle test, ultrasonic test, radiographic test

**Note:**

- *An expert from some industry may be invited for the lecture.*
- *Industrial visit may be planned.*

**LIST OF PRACTICALS**

1. Setting of flame length and colour for gas welding.
2. Edges Preparation of metal for welding.
3. Setting appropriate current and voltage for thin and thick work pieces and electrodes selection.
4. Welding Practice for lap welding and Butt welding.
5. Practice of vertical and overhead welding.
6. Practice of forward and backward welding.
7. Practice of welding pipes by electric arc welding technique.
8. Practice of Soldering and Brazing.
9. Testing of welded Joints.
10. Identification and Rectification of welding defects in plates and pipe joints.

**RECOMMENDED BOOKS**

1. Manufacturing Technology: Vol. 1 - Foundry, Forming and Welding by P.N.Rao; McGraw Hill Higher Education publication
2. A Text-Book of Welding Technology by O.P. Khanna
3. Modern welding technology Book by Howard B. Cary
4. Practical Welding Technology Book by Rudy Mohler
5. Welding: Principles and Applications Book by Larry Jeffus

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	06	10
2	08	12
3	08	12
4	08	12
5	10	14
6	06	10
7	06	10
8	06	10
9	06	10
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.5.3 TOOL ENGINEERING

L T P

4 - 2

### RATIONALE

*Diploma Holders in Mechanical Engineering are required to supervise production to meet production target. For that it is necessary for them to ensure that various machine tool and tooling equipment's remain in working order. For this purpose, knowledge about jigs and fixture, press tools and other tooling equipment's is essential. Hence this subjects. The subjects aims at development of knowledge and skills regarding press tools, jigs & Fixtures and other equipment's for increased productivity and quality.*

### DETAILED CONTENTS

- 1. Cutting Tools Materials (12 hrs)**
  - 1.1 Requirements of Cutting tools materials
  - 1.2 Factor affecting selection of tools materials
  - 1.3 Various cutting tools materials used
  - 1.4 Development in cutting tool material
  - 1.5 Various cutting tools materials used
  - 1.6 Development in cutting tool material-UCON, CBN, Coated, Multicoating
  
- 2. Jigs & Fixtures (24 hrs)**
  - 2.1 Definition, purpose and basic elements
  - 2.2 Principles of designing Jigs and fixture
  - 2.3 Work holding Devices
  - 2.4 Degree of Freedom
  - 2.5 3-2-1 Principle of location
  - 2.6 Locating Devices
  - 2.7 Various Clamping Devices
  - 2.8 Tools Guiding methods and guide bushing
  - 2.9 Types of Drill Jigs and their applications
  - 2.10 Common Types of milling fixtures
  - 2.11 Welding Fixtures
  
- 3. Press Tools (28 hrs)**
  - 3.1 Basic of press tool working
  - 3.2 Press tool terms and main parts
  - 3.3 Power Presses-working and classification
  - 3.4 Die Sets-Types
  - 3.5 Nomenclature of cutting dies
  - 3.6 Theory of cutting dies such as blanking, piercing, notching, cutting off, trimming.
  - 3.7 Scrap strip layout
  - 3.8 Feeding Mechanism
  - 3.9 Cutting and stripper force calculations
  - 3.10 Punches, Dies, Pilots, Strippers, stops, Knockouts - their design and material selections
  - 3.11 Forming operations such as bending, curling with exposures to embossing, coining drawing, deep drawing.

- 3.12 Working of compound and progressive tool
- 3.13 Single action and double action presses
- 3.14 Design of press tools for forming operation
- 3.15 Design of press tools for forming operations
- 3.16 Design of compound and progressive type of press tools

**LIST OF PRACTICALS**

- 1. Study and sketch a single point cutting tool geometry.
- 2. Practice on grinding of single point cutting tool.
- 3. Design and drawing of a drill jig for a given component.
- 4. Design and drawing of a milling fixtures (dividing head) for a given job.
- 5. Study of a wire drawing die.
- 6. Making and drawing of blanking and trimming tool.
- 7. Study of compound press tool.
- 8. Study and drawing of general arrangement of progressive press tools.

**RECOMMENDED BOOKS**

- 1. Rao, P.N., Manufacturing Technology, Vol I & II, Tata Mcgraw Hill Publishing Co., New Delhi, 1998
- 2. Seropekalpakjian, Steven R Schmid Manufacturing Engineering and Technology- Pearson Education-Delhi
- 3. Sharma, P.C., A Textbook of Production Technology – Vol I And II, S. Chand & Company Ltd., New Delhi, 1996
- 4. HMT – “Production Technology”, Tata Mcgraw-Hill, 1998

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	12	15
2	24	40
3	28	45
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.5.4 MECHATRONICS

L T P  
4 - 2

### RATIONALE

*In this increasingly competitive environment of the day, the rapid advancements in the field of electronics engineering, information technology, automation and system engineering etc have been responsible for involving new concepts aimed at developing highly precision and sophisticated machine tools, system etc. for hence productivity. Hence, the diploma holders need knowledge and skills on the multi-disciplinary area and linking with the mechanical engineering. This subject e.g. Mechatronics aims at developing required knowledge and skills in this area.*

### DETAILED CONTENTS

- 1. Introduction (05 hrs)**
  - 1.1 Introduction to Mechatronics
  - 1.2 Mechatronic system
  - 1.3 Measurement systems
  - 1.4 Control system-open Loop, Close loop and sequential
  - 1.5 Microprocessor based controllers
  - 1.6 The Mechatronics approach
  
- 2. Sensors and Transducers (10 hrs)**
  - 2.1 Sensors and transducers
  - 2.2 Performance terminology
  - 2.3 Displacement, position and motion sensors
  - 2.4 Electromechanical sensors and transducers
  - 2.5 Force sensors
  - 2.6 Liquid flow sensors
  - 2.7 Temperature sensors
  - 2.8 Light sensors
  - 2.9 Selection of sensors
  - 2.10 Simple problems
  
- 3. Data Presentation Systems (08 hrs)**
  - 3.1 Displays
  - 3.2 Data presentation elements
  - 3.3 Magnetic recording
  - 3.4 Data acquisition systems
  - 3.5 Measurement systems
  - 3.6 Testing and calibration
  - 3.7 Simple problems
  
- 4. Pneumatic and Hydraulic Systems (08 hrs)**
  - 4.1 Actuation systems
  - 4.2 Pneumatic and hydraulic systems
  - 4.3 Directional control valves
  - 4.4 Pressure control valves
  - 4.5 Cylinders
  - 4.6 Process control valves
  - 4.7 Rotary actuators

- 5. Mechanical Actuation Systems (06 hrs)**
- 5.1 Mechanical systems
  - 5.2 Cams
  - 5.3 Gear trains
  - 5.4 Ratchet and pawl
  - 5.5 Belt and chain drives
- 6. Electrical Actuation System (09 hrs)**
- 6.1 Electrical systems
  - 6.2 Mechanical switches
  - 6.3 Solid-state switches
  - 6.4 Solenoids
  - 6.5 D.C. motors
  - 6.6 A.C. motors
  - 6.7 Stepper motors
- 7. Microprocessors & PLC (08 hrs)**
- 7.1 Microcomputer structure
  - 7.2 Microcontrollers
  - 7.3 Applications
  - 7.4 Programmable logic controller – applications
  - 7.5 Basic structure, input/output processing
- 8. Microcomputer controlled devices and applications (10hrs)**
- 8.1 SRS components
  - 8.2 Crash avoidance features (ESC, TCS and ABS)
  - 8.3 Electronic control transmission
  - 8.4 Collision avoidance radar warning system
  - 8.5 Keyless entry and automatic head lamps

### **RECOMMENDED BOOKS**

1. Mechatronics by HMT, Tata McGraw Hill, New Delhi
2. Mechatronics: Electronic Control System in Mechanical Engineering by W. Bolton; Pearson Education, Singapore
3. Mechatronics-Principles, Concepts and Applications by Nitaigour Premch and Mahalik Tata McGraw-Hill Pub.
4. Automotive Electrical and Electronics by AK Babu

### **LIST OF PRACTICALS**

1. To develop hydraulic circuit using different components
2. Layout of temperature sensor circuit.
3. Study and layout circuit of D.C. Shunt motor and stepper motor
4. Fault tracing of different sensors through engine car scanner
5. Fault tracing of supplementary restraint system (SRS)
6. Study of ABS, traction control system model
7. PLC basic circuits and control.



### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	05	10
2	10	15
3	08	12
4	08	12
5	06	10
6	09	14
7	08	12
8	10	15
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.5.5 POWER PLANT ENGINEERING

L T P  
4 - 2

### **RATIONALE**

*In India, even today, short fall of power generation is about 30 percent. Fuel supply and distribution is also an area where country is still developing smooth lines of supply. Since power and energy is required by every sector of economy, the growth in this sector is must if Indian economy grows in any sector. Many of the job opportunity in private as well as public sector are therefore waiting for students in this field. Hence, this course attempts to provide them basic knowledge of the technologies available at plant level and would also acquaint them with the latest technological advances taking place in this sector. The diploma holder should have the knowledge of the various type of power plants being used to generate electricity and their equipment.*

### **DETAILED CONTENTS**

#### **1. Introduction**

**(6 hrs)**

Energy resources and their availability, Types of power plant, selection of the plants, review of basic thermodynamics cycles used in power plant.

#### **2. Hydro Electric Power Plant**

**(12 hrs)**

Rainfall and run-off measurements and plotting of various curves for estimating power plants, design, construction and operation of different components of hydro-electric power plant, site selection, comparison of other types of power plants.

#### **3. Steam Power Plants**

**(12 hrs)**

Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

#### **4. Gas Turbine Power Plants**

**(10 hrs)**

Types, open and closed gas turbine, work output & thermal efficiency, methods to improve thermal efficiency of gas turbine plant-reheating, inter-cooling regeneration & their combinations, advantage and disadvantages, comparison with steam power plant.

#### **5. Nuclear Power Plants**

**(8 hrs)**

Principles of nuclear energy, basic nuclear reactions, nuclear power station, trouble shooting and remedies. Power Plant.

#### **6. Non-Conventional Power Generation**

**(8 hrs)**

Solar radiation, solar energy collectors, OTEC, wind power plants, geothermal resources.

#### **7. Direct Energy Conversion Systems**

**(8 hrs)**

Fuel cell, principle of thermoelectric power generation, thermionic power generation.

## LIST OF PRACTICALS

1. Prepare list of various major power plants installed in Himachal Pradesh along with their total capacity.
2. Visit websites of NTPC, BHEL etc and find out the technical information about their machineries or Plants.
3. Study of high pressure boilers (any three): Students would: a. Demonstrate working of boilers and different components on them. (Actual or Video). b. Draw schematic diagram with labels for each. c. Write specification of each boiler. d. List functions and explain working of different components of each boiler.
4. Faculty will assign any one topic from following. i. Steam based power plant along with auxiliaries. ii. Gas turbine power plant. iii. Solar power plant. iv. Wind power plant. v. Hydro Electric power plant. vi. Any other relevant assigned by batch teacher. Students would prepare a model on the topic assigned by batch teacher using preferably waste material. a. Prepare work distribution matrix. b. Prepare the schematic diagram. c. Prepare model diagram with dimensions. d. List steps to be followed to prepare the model.
5. Faculty would arrange industrial visit on any one of following (Compulsory):
  - i. Thermal power plant. ii. Gas turbine power plant. iii. Hydroelectric power plant. iv. Wind turbine power plant. Student would prepare report on visit. Report should include specification of plant, circuit diagram, working principle of major components, etc.

## RECOMMENDED BOOKS

1. Power station Engineering and Economy by Bernhardt G.A. Skrotzki and William A.Vopat -Tata McGraw Hill
2. Power Plant Engineering by P.K. Nag-Tata McGraw Hill
3. Power Plant Engineering by P.C. Sharma- S.K. Kataria & Sons

## REFERENCE BOOKS

1. An Introduction to Power Plant Technology by G.D. Rai- Khanna Publishers
2. A Course in Power Plant Engineering by Arora and Domkundwar– Dhanpat Rai Publications
3. Power Plant Engineering by M.M. El-Wakil-McGraw Hill
4. Power Plant Engineering, Power Plant Engineering, Gupta, PHI Learning Private Limited

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1	06	10
2	12	20
3	12	20
4	10	20
5	08	10
6	08	10
7	08	10
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.6 MINOR PROJECT

L T P

- - 6

### **RATIONALE**

*Pre- Project aims at enabling the students apply the theory and practical knowledge gained during the previous semesters. The students are expected to select a industrial problem/ innovative idea to work on during the pre-project and **will continue in the final project in sixth semester**. The work done in pre project will also prepare them in taking up problem solving at latter stage. Depending upon the interests of the students and location of the organization the student shall carry out the following activities:*

### **Idea Generation (Start-up ideas)**

- To carry out the brain storming for generation/creation of new ideas and their analysis.

### **Market survey**

- To study the sources of supply of various types of engineering materials and procedure for purchase of material
- To study the present need of the market and the society.
- To get the quotations from different suppliers, compare and preparations of supply order.
- To identify the various agencies for promoting entrepreneurship.

### **Workshop study**

- To study the various types of machines to use in manufacturing of different mechanical engineering projects and precautions to be taken.
- To study the different methods of manufacturing of a project.
- Handling of measuring and testing equipment's

### **Analytical study**

- To analyse the different manufacturing methods for a project and select the optimum method
- To analyse the economical aspects of the project.

### **Project report**

- **Preparation of pre- project report**

### **Presentation**

- To present the work carried out during the pre-project.

### **Suggested evaluation :**

- |                                     |     |
|-------------------------------------|-----|
| • Punctuality and regularity        | 15% |
| • Initiative in learning new things | 15% |
| • Relationship with others/workers  | 15% |
| • Project Report/ Technical report  | 55% |

## 5.7 PRACTICES IN COMMUNICATION SKILLS

L T P

- - 2

### RATIONALE

*For successful completion of diploma programme, the students should possess adequate command on language and communication skills so that they are able to express themselves with ease and felicity. The language used by the students should be appropriate to objectives and occasion. The contents of this subject shall provide them practical training through language laboratory.*

### LIST OF PRACTICALS

1. **Exercises on phonetics** (8 hrs)
  - 1.1 Identifications of English phonemes
  - 1.2 Stress and Intonation
  - 1.3 Speaking exercises with emphasis on voice modulation (reading and extempore)
2. **Group Discussion** (4 hrs)
3. **Exercises on** (4 hrs)
  - Self-assessment using tools like SWOT analysis
  - Listening skills
4. **Internet communication and Correspondence** (4 hrs)
  - 4.1 Resume writing
  - 4.2 Covering letter
  - 4.3 Agenda and Minutes of meeting
  - 4.4 Business Correspondence
5. **Exercises on** (4 hrs)
  - 5.1 Body language and Dress sense
  - 5.2 Etiquettes and mannerism in difficult situations like business meetings, table manners, Telephone etiquette
  - 5.3 Manners related to opposite gender
  - 5.4 Cross-cultural Communication
6. **Mock interviews** (telephonic/personal) (4 hrs)
7. **Role plays for effective Communication** (4 hrs)

## 6.1 PRODUCTION PLANNING AND CONTROL

L T P

4 - -

### RATIONALE

*Diploma holder in this course is responsible for controlling production and quality of the product on the shop floor as well as for production planning and control. He is also required to supervise erection, installation and maintenance of equipment including material handling and undertake work-study for better utilization of resources. For this purpose, knowledge and skills about these topics need to be imparted to them. This subject aims at development of competencies to prepare material, equipment schedule and production control schedules and maintain required quality levels. In addition, it will also help in developing skills in erection, installation and testing of equipment.*

### DETAILED CONTENTS

- 1. Production Planning and Control (04 hrs)**
  - 1.1 Types of production. - Job, batch and mass production
  - 1.2 Concept of planning, scheduling, routing, dispatching and follow up
  - 1.3 Break even analysis and Gantt chart
  
- 2. Plant Location and Layout (08 hrs)**
  - 2.1 Definition
  - 2.2 Factors affecting the site selection of plant
  - 2.3 Factors affecting plant layout
  - 2.4 Types of layout - Process, product, combination and fixed position, layout patterns
  - 2.5 Techniques of making layout - Flow diagram, templates, distance volume matrix, travel chart
  
- 3. Work Study (12 hrs)**
  - 3.1 Definition, advantages and procedure of Work study
  - 3.2 Difference between production and Productivity, measures to improve productivity.
  - 3.3 Method study - Definition, Objectives and Procedure
  - 3.4 Symbols, Flow process chart, Flow diagram, Machine chart, Two hand chart.
  - 3.5 Principles of motion economy, Therblig symbols, Simo chart
  - 3.6 Work Measurement - Time study, definition, principle and method of time study
  - 3.7 Stop watch study - Number of readings, calculation of basic time, rating techniques, normal time, allowance, standard time.
  
- 4. Inventory Control (10 hrs)**
  - 4.1 Material purchasing, store keeping, functions and duties of store department.
  - 4.2 Definition of inventory, Types of inventory
  - 4.3 ABC analysis
  - 4.4 Procurement cost, carrying charges, lead-time, reorder point, Economic ordering quantity, simple numerical problems.
  - 4.5 Codification and standardization
  - 4.6 Concept of JIT

**5. Inspection and Quality Control (08 hrs)**

- 5.1 Inspection needs, types of inspection, stages of inspection
- 5.2 Statistical quality control
- 5.3 Process capability
- 5.4 Control charts for variables – X and R chart, control chart for fraction defectives (P chart), control chart for number of defects (C chart)
- 5.5 Concept of ISO 9000, ISO 14000 and TQM
- 5.6 QC tools

**6 Material Handling (06 hrs)**

- 6.1 Principles of material handling
- 6.2 Hoisting equipment - Fork lift truck, cranes
- 6.3 Conveying equipment - Package conveyor, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, bucket elevators, belt conveyors, and pneumatic conveyors.
- 6.4 Work station design

**7 Repair and maintenance (07hrs)**

- 7.1 Objectives and importance of maintenance
- 7.2 Different types of maintenance
- 7.3 Nature of maintenance problem
- 7.4 Range of maintenance activities
- 7.5 Procedure of preventive maintenance
- 7.6 Schedules of preventive maintenance
- 7.7 Advantages of preventive maintenance

**8. Cost estimation and control (09 hrs)**

- 8.1 Functions of cost estimation
- 8.2 Estimation procedure
- 8.3 Elements of cost, ladder of costs
- 8.4 Depreciation-concept and methods of calculating depreciation
- 8.5 Overhead expanses
- 8.6 Cost control - capital cost control (planning and scheduling) operating cost control.

**RECOMMENDED BOOKS**

- 1. Industrial Engineering and Management by T.R. Banga and SC Sharma; Khanna Publishers, Delhi
- 2. Industrial Engineering and Management by O.P. Khanna; Dhanpat Rai and Sons, New Delhi
- 3. Production Management by C.L. Mahajan; Satya Parkashan Company Limited, New Delhi
- 4. Mechanical Costing, Estimation and Project Planning by CK Singh; Standard Publishers, New Delhi
- 5. A Text Book of Reliability and Maintenance Engineering by A Manna, Prentice Hall of India

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	04	10
2	08	10
3	12	18
4	10	16
5	08	12
6	06	10
7	07	12
8	09	12
<b>Total</b>	<b>64</b>	<b>100</b>



## 6.2 REFRIGERATION AND AIR CONDITIONING

L T P

4 - 2

### RATIONALE

*Diploma holders in Mechanical engineering are responsible for supervising production and maintenance of refrigeration and air conditioning systems. For this purpose, knowledge and skills covering principles of refrigeration and air conditioning, various refrigeration and air conditioning systems, psychometry are required to be imparted to them. Hence this subject.*

### DETAILED CONTENTS

- 1. Principles of Refrigeration (08 hrs)**
  - 1.1 Meaning
  - 1.2 Refrigeration Methods
  - 1.3 Units of Refrigeration
  - 1.4 Reversed Carnet cycle
  - 1.5 Heat pump
  - 1.6 Coefficient of Performance
  - 1.7 Rating of refrigeration machines
  
- 2. Refrigeration Systems (10 hrs)**
  - 2.1 Air refrigeration cycle- applications and its limitations
  - 2.2 Vapour Compression Cycle
  - 2.3 Effect of sub cooling and super heating
  - 2.4 Departure of Actual vapour compression cycle from theoretical cycle
  - 2.5 Effect of varying condensing and suction temperature on coefficient of performance.
  - 2.6 Simple mathematical calculation with pressure-enthalpy charts.
  - 2.7 Vapour Absorption cycle
  - 2.8 Actual vapour absorption cycle and application
  
- 3. Refrigerants (08 hrs)**
  - 3.1 Important properties of a refrigerant
  - 3.2 Properties and applications of commonly used refrigerants such as R11, R12, R22, NH<sub>3</sub> and Water.
  - 3.3 Newer Refrigerants
  
- 4. Refrigeration System, Components and Controls (08 hrs)**
  - 4.1 Function, types, specification and constructional details of components such as compressor, condenser, throttling device, evaporator, oil separator, accumulator, header.
  - 4.2 Various controls- Solenoid Valve, thermostat, low pressure/high pressure cut out, oil safety switch
  
- 5. Psychometry (08 hrs)**
  - 5.1 Various terms-Dry and wet bulb temperatures, Saturation, Dew point, adiabatic saturation, temperature, Relative humidity, absolute humidity, humidity ratio.
  - 5.2 Psychometric chart and its uses
  - 5.3 Psychometric processes-Sensible heating and sensible cooling, humidification and dehumidification, cooling and dehumidification, heating and humidification, and their representation on psychometric chart.
  - 5.4 Simple Problems

- 6. Air-conditioning** (06 hrs)
- 6.1 Introduction
  - 6.2 Metabolism in human body
  - 6.3 Human comfort
  - 6.4 Applications of air-conditioning
- 7. Heat Loads** (06 hrs)
- 7.1 Various types of loads
  - 7.2 Sensible and latent heat load
  - 7.3 Load calculations
- 8. Air-conditioning System** (06 hrs)
- 8.1 Description of room air conditioner
  - 8.2 Central air-conditioning system
  - 8.3 Round the year air conditioning system
  - 8.4 Air distribution systems: concept of filter, damper, fan, blower, air register and diffuser
- 9. Miscellaneous Topics** (04 hrs)
- 9.1 Evaporative cooling - Principle, Desert air cooler

#### **LIST OF PRACTICALS**

1. Practice in :- i) Tube cutting ii) Tube Flaring iii) Tube bending iv) Tube joining
2. Study and sketch of domestic refrigerator.
3. Study and sketch of water cooler.
4. Study and sketch window type room air conditioner
5. Testing of a refrigeration unit to find out:
  - i) Refrigeration capacity
  - ii) Power input
  - iii) COP
6. a) Charging refrigerant in an open as well as hermetically sealed units.  
b) Physical detection of leakage of refrigerant by various methods.
7. To detect troubles/faults in a refrigeration system and to remove them.
8. Visit to an ice plant / cold storage plant/central conditioning plant.
9. Study and sketch of various types of expansion devices & Humidity state.
10. Study and sketch of thermostat, strainer, drier, H.P. L.P. and oil safety control and service valve, two way & three ways valves, relays & solenoid valve etc.

#### **RECOMMENDED BOOKS**

1. Refrigeration & air conditioning by Domkundwar, Dhanpat Rai & Sons
2. Refrigeration and Air Conditioning by C.P Arora Tata Mc Graw Hills
3. Refrigeration and Air Conditioning by R.S Khurmi by S Chand and Company
4. Refrigeration & Air condition by A.S Saroq Satyaprakashan

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	08	12
2	10	15
3	08	12
4	08	12
5	08	15
6	06	10
7	06	12
8	06	07
9	04	05
<b>Total</b>	<b>64</b>	<b>100</b>

## 6.3 AUTOMOBILE ENGINEERING

L T P

4 - 2

### RATIONALE

*These days, automobiles have become a necessity instead of luxury. There has been phenomenal development of automobile industry. The Diploma holders in Mechanical Engineering are required to supervise production and repair and maintenance of vehicles. For this purpose, knowledge and skills are required to be imparted to them regarding automobile industry as a whole. This subject aims at developing required knowledge and skills in this area.*

### DETAILED CONTENTS

- 1. Introduction (04 hrs)**
  - 1.1 Components of an automobile
  - 1.2 Classification of automobiles
  - 1.3 Layout of chassis
  - 1.4 Types of drives-front wheel, rear wheel, four wheel, left hand, right hand
  - 1.5 Introduction to electric vehicle
  
- 2. Transmission System (20 hrs)**
  - 2.1 Clutch Function, Constructional details of single plate and multi plate friction clutches, Centrifugal and semi centrifugal clutch
  - 2.2 Gear Box: Function, Working of slide mesh, constant mesh and synchro mesh gear box, Torque converter and overdrive
  - 2.3 Propeller shaft and rear axle Function, Universal joint, Differential, Rear axle drives and different types of rear axles
  - 2.4 Wheels and Tyres  
Types of wheels- disc wheels and wire wheel, Types of tyres used in Indian vehicles, Causes of tyre wear, Toe in, Toe out, Camber, Caster, Kingpin inclination, Tube less tyres
  
- 3. Steering System (06 hrs)**
  - 3.1 Function and principle
  - 3.2 Ackerman and Davis steering gears
  - 3.3 Types of steering gears- worm and nut, worm and wheel, Rack and pinion type
  - 3.4 Introduction to power steering
  
- 4. Braking System (08 hrs)**
  - 4.1 Constructional detail and working of mechanical, hydraulic and vacuum brake.
  - 4.2 Concept of brake adjustment & Bleeding of brakes
  - 4.3 Introduction to ABS, EBD and hill assist braking system
  - 4.4 Introduction to Traction control
  
- 5. Suspension System (04 hrs)**
  - 5.1 Function
  - 5.2 Types
  - 5.3 Working of coil spring, leaf spring
  - 5.4 Shock absorber

**6. Battery (06 hrs)**

- 6.1 Constructional details of lead and cell battery
- 6.2 Specific gravity of electrolyte
- 6.3 Effect of temperatures, charging and discharging on specific gravity
- 6.4 Capacity and efficiency of battery
- 6.5 Battery charging
- 6.6 Maintenance of batteries
- 6.7 Checking of batteries for Voltage and specific gravity

**7. Dynamo and Alternator (06 hrs)**

- 7.1 Dynamo, Function and details, Regulators-voltage, current and compensated type, Cut out-Construction, working and their adjustment.
- 7.2 Alternator, Construction and working, Charging of battery from alternator

**8. Introduction to special purpose vehicles (04 hrs)**

- 8.1 Tractors
- 8.2 Forklift
- 8.3 Cranes & Recovery vehicles

**9. Lighting System and Accessories (06 hrs)**

- 9.1 Introduction to Lighting system of automobile
- 9.2 Windscreen Wiper
- 9.3 Horn
- 9.4 Speedometer
- 9.5 HVAC system

**LIST OF PRACTICALS**

1. Study of different types of clutches and adjust the clutch pedal play.
2. Study of front axle, rear axle and differential of an automobile.
3. Study of different types of gear box.
4. Study of steering system of the automobile.
5. Study of hydraulic brake system of an automobile, bleeding of hydraulic brakes.
6. Procedure of rotation of wheels, balancing of wheels and alignment of wheels.
7. Charging of lead acid battery, measuring cell voltage and specific gravity.
8. Study of dynamo/alternator of an automobile and fan belt adjustment.
9. Study of different electrical accessories of an automobile.
10. Spark plug cleaning and gap setting.
11. Driving practice on four wheelers one hour/student in the semester.

**RECOMMENDED BOOKS**

1. Automobile Engineering by Kirpal Singh, Standard Publishers
2. Automobile Engineering by GBS Narang, Khanna Publishers
3. Automobile Mechanics by Joseph Heitner, CBS Publishers

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1.	04	08
2.	20	25
3.	06	10
4.	08	15
5.	04	08
6.	06	10
7.	06	08
8.	04	08
9.	06	08
<b>Total</b>	<b>64</b>	<b>100</b>

## 6.4 COMPUTER AIDED DRAFTING

L T P  
- - 4

### RATIONALE

*The diploma holders are required to integrate the drawings through a soft copy to the machines during production. Thus competency in computer aided drafting is essential. Hence this subject is required.*

### DETAILED CONTENTS

#### 1. Introduction to CAD

- Introduction to CAD: - Advantages and applications, setting the drawing environment: Limits, Grid, Snap, Axis, Units, Ortho, Coordinates ON, OFF Units and Color.
- 2D Drawing entities - Point - Line - Arc - circle, Ellipse, Polygon, and Trace. Object Selection using Object Snap (OSNAP).
- Editing commands: Selection of entities by different methods - copy, Move, Scale, Rotate, Fillet, Chamfer, Mirror, Array-Polar, Rectangular. Measure, Divide, and Erase.
- Drawing Display Methods: Zoom, Pan, and View.
- Adding Texts and Dimensions: Text, Dimension-linear, continued, angular

#### 2. More Learning for Productivity of Drawing

- Pedit commands. Working on multiple layers Layer concepts in CAD
- Various options with layer command - Hatch command - Creating line types library and user made library.
- Preparing the schematic drawing of a workshop building in one layer, the blocks of machines in another Layer and Electrical connection on another layer.

#### 3. Advanced CAD Features

- Drawing 2D figure of complex shape
- Extruding it into a 3D drawing
- Understanding 3D Co-ordinate values, Creating and viewing a drawing in 3D.
- Rotating the drawings- Meshing 3D drawing.
- Turning a 3D into 2D Ortho Graphic projection.

#### 4. Advanced 3D Features

- Understanding model space and paper space.
- Drawing and working in UCS.
- UCS icon, 3D editing-Union, Subtraction, 3 D Orbit.
- Basic 3D entities command, Box, Cylinder, Cone, Chamfer, Revolve.

#### 5. Drawing of Following Automobile components

- a) 2D drawings
  - Connecting rod, Gear tooth profile
  - Brake assembly, Single plate clutch
- b) 3D drawings
  - Universal coupling
  - Protected type flange coupling
  - Meshing gears

#### CAD Setup and Presentation

- Developing CAD slides and presenting it.
- Configuring the CAD package with the following settings.
- One User&1SM SVGA monitor
- Microsoft Serial Mouse at COM
- DMP 52 plotter at COM2

## 6.5 CNC MACHINES AND AUTOMATION

L T P

4 - 4

### RATIONALE

*Diploma holders are required to supervise and handle specialized machines and equipment like CNC machines. For this purpose, knowledge and skills about NC machines, part programming in NC machines and tooling for CNC machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about CNC machines, tools, equipment and use of high tech machines for increased productivity and quality.*

### DETAILED CONTENTS

#### 1. Introduction

(08 hrs)

Basic concepts of NC, CNC & DNC, advantages & disadvantage of CNC Machines, Application of CNC Machines, difference between conventional & CNC Machines, Profitable applications of CNC Machines. Introduction to CAM.

#### 2. Construction of CNC Machines

(16 hrs)

Machine control unit, NC control, PLC control, its advantages & disadvantages, Application and limitations of PLC machines, Axis designate of CNC machines, special constructional requirement of CNC machines, slide ways, bolt screw & nut assembly, Lubrication & cooling of CNC machines, Spindle & spindle motors, axis drives motor, Swarf removal & safety provision of CNC machines, Feedback mechanism in CNC machines.

#### 3. Tooling of CNC Machines

(08 hrs)

Introduction, various cutting tools for CNC machines, Work holding devices, automatic tool changer.

#### 4. Control System

(10 hrs)

Open & close loop control system, fundamental problem in control: Accuracy, resolution, repeatability, instability, response & damping, type of position control:

- Point to point
- Straight line
- Continuous

#### 5. Part Programming

(10 hrs)

Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using conned cycles, subroutines and do loops, tool off se cutter radius compensation and wear compensation

#### 6. Common Problems in CNC Machines

(06 hrs)

Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines

#### 7. Industrial Automation

(06 hrs)

Meaning of automation, need of automation, different types of automation, advantages/ disadvantages of automation, Components of automated system, concept of FMS.



## LIST OF PRACTICALS

1. Study the constructional details of CNC lathe.
2. Study the constructional details of CNC milling machine.
3. Study the constructional details and working of:
  - Automatic tool changer and tool setter
  - Multiple pallets
  - Swarf removal
  - Safety devices
4. Fundamental of part programming for 2- axis and 3-axis
  - Plain turning and facing operations
  - Taper turning operations
  - Thread cutting operations
  - Operation along contour using circular interpolation
5. Develop a part programme for the following milling operations and make the job on CNC milling machine
  - Plain milling
  - Slot milling
  - Pocket milling
6. Preparation of work instruction for machine operator.
7. Preparation of preventive maintenance schedule for CNC machine.
8. Demonstration through industrial visit for awareness of actual working of FMS in production.
9. Use of software for turning operations on CNC turning center.
10. Use of software for milling operations on machine centres.

## RECOMMENDED BOOKS

1. CNC Machines - Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi
2. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata Mc GrawHill, New Delhi
3. CNC Machine by Bharaj; Satya Publications, New Delhi

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1	08	12
2	16	28
3	08	12
4	10	16
5	10	16
6	06	08
7	06	08
<b>Total</b>	<b>64</b>	<b>100</b>

## 6.6 AUTOMATION LAB

L T P

- - 2

### **RATIONALE**

*This course provides an overall exposure to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course discusses a wide range of related topics from architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, CNC Machines.*

### **LIST OF PRACTICALS**

1. Use of Multimeter to measure current, voltage and continuity of an electric circuit.
2. Study the working of digital proximity sensors.
3. Use of linear potentiometer as an analog transducer.
4. Study of sensors for measurement of temperature, liquid level, speed and force.
5. Study of drive to control speed of AC motor and DC motor.
6. Study and speed control of stepper motor.
7. Exercise on Boolean algebra and digital logic.
8. Study of PLC – Basic circuits and programming.
9. Study of electro hydraulic and electro pneumatic circuits using different components.
10. Exercise on interfacing PLC with different sensors and actuators.

## 6.7 MAJOR PROJECT

L T P

- - 8

### RATIONALE

The final project is the continuation of the pre-project. The practical training cum project work is intended to place students for project oriented practical training in actual work situations for the stipulated period with a view to:

- i) Develop understanding regarding the size and scale of operations and nature of field work in which students are going to play their role after completing the courses of study.
- ii) Develop understanding of subject based knowledge given in the class room in the context of its application at work places.
- iii) Develop first-hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems in the world of work.
- iv) Develop special skills and abilities like interpersonal skills, communication skills, attitudes and values.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with minimal supervision. This experience is required to be planned and supervised on regular basis by the polytechnic faculty. For the fulfilment of above objectives, polytechnic may establish close linkage with 8-10 relevant organization for providing such an experience. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such which are of curricular interest to students and of professional value to industrial/field organizations. Each teacher is expected to supervise and guide 5-6 students.

Effort should be made to identify actual field problems as project work for the students. Project selected should not be too complex which is beyond the level of the students. The placement of the students for such a practical cum work should match with the competency profile of students and the work assigned to them. Students may be assessed both by industry polytechnic faculty. The suggested performance criteria is given below:

- a) Punctuality and regularity
- b) Initiative in learning/working at site
- c) Level/proficiency of practical skills acquired
- d) Ability of solve live practical problems
- e) Sense of responsibility
- f) Self expression/communication skills
- g) Interpersonal skills/Human Relation
- h) Report Writing Skills
- i) Viva-voce

The projects given to students should be such for which someone is waiting for solution. Some of the suggested project activities are given below

- a) Projects connected with repair and maintenance of machine parts.
- b) Estimating and costing projects
- c) Design of components/parts/jigs/fixtures.
- d) Projects related to quality control.
- e) Project work related to increasing productively.
- f) Project connected with work study.
- g) Projects relating to erection, installation, calibration and testing.
- h) Projects related to wastage reduction.
- i) Problem related to value analysis/value engineering
- j) Project related to mistake proofing.

