

# **CURRICULUM**

FOR

**DIPLOMA PROGRAMME**

IN

**MECHANICAL ENGINEERING**

**3<sup>rd</sup> Year (i.e. 5<sup>th</sup> & 6<sup>th</sup> semester)**

FOR THE STATE OF HIMACHAL PRADESH

(To be implemented from session 2013-2014)



*(Implemented w.e.f. Session 2014-15)*

*Prepared by:-*

**Composite Curriculum Development Centre  
Directorate of Technical Education,  
Vocational & Industrial Training, Sundernagar(H.P.)**

July, 2014

## CONTENTS

SR.NO.	PARTICULARS	PAGE
-	Contents	1
-	Preface	2
1.	<b>Salient Features of the Diploma Programme</b>	<b>3</b>
2.	<b>Guidelines</b> <i>(for Assessment of Student Centered Activities and Sessional assessment)</i>	<b>4</b>
3.	<b>Study and Evaluation Scheme</b>	<b>5-6</b>

<b>FIFTH SEMESTER</b>		
5.1	Automobile Engineering	7-9
5.2	Machine Design	10-11
5.3	Production Planning and Control	12-14
5.4	Manufacturing Processes-III	15-16
5.5	<b>Elective-I</b>	
	5.5.1 Mechatronics	17-19
	5.5.2 Installation Testing & Maintenance	20-22
	5.5.3 Foundry Technology	23-25
	5.5.4 Welding Technology	26-28
	5.5.5 Product Design & Development	29-30
	5.5.6 Heat Treatment	31-32
	5.5.7 Tool Engineering	33-34
5.6	Generic Skill & Entrepreneurship Development	35-37
<b>SIXTH SEMESTER</b>		
6.1	Basic of Management	38-40
6.2	Refrigeration & Air Conditioning	41-43
6.3	Metrology and Instrumentation	44-46
6.4	CAD	47-48
6.5	CNC Machines and Automation	49-51
6.6	Project Work	52-53
6.7	Practice in Communication Skills	54

## PREFACE

*India, in last two decades, has made significant progress in all major spheres of activity. Since 1947, the Technical Education System has grown into fairly large sized system, offering opportunities for education and training in wide variety of trades / disciplines at different levels. Needless to say that well trained technical manpower is the backbone of any growing economy in the era of fast industrialization. It has been the endeavor of the Technical Education Department to take decisive steps to enhance the capacities of technical institutions with major emphasis on quality and excellence in technical education .Our country is the only country in the world which has 50% population below the age of 25 years whereas America has 30% and China 40%.Working Age Population (WAP) is increasing in India whereas it is decreasing in other parts in the world. Challenge before us is to train this WAP for the world of work .Updated curriculum is one of the most powerful tools to improve the quality of training.*

*Curriculum Document is a comprehensive plan or a blue print for developing various curriculum materials and implementing given educational programme to achieve desired and formally pre-stated educational objectives. Moreover it (the document) is the output of exhaustive process of curriculum planning and design, undertaken by the implementers under the expert guidance of curriculum designer.*

*While working out the detailed contents and study and evaluation scheme, the following important elements have been kept in mind:*

- i) Major employment opportunities of the diploma holders.*
- ii) Modified competency profile of the diploma holders with a view to meet the changing needs due to technological advancement and requirements of various employment sectors.*
- iii) Vertical and horizontal mobility of diploma pass outs for their professional growth.*
- iv) Pragmatic approach in implementing all the curricula of diploma programmes in engineering and technology in the state of H.P.*

*The document is an outcome of the feedback received from field organizations/ industry of different categories viz. small, medium and large scale which offer wage employment for the diploma pass outs. In every stage of planning and designing of this curriculum, suggestions and advice of experts representing industry, institutions of higher learning, research organizations etc. were sought and incorporated as per the requirement of curriculum . The document contains the study and evaluation scheme and detailed subject/course contents to enable the H.P. Polytechnics to implement revised curriculum and to achieve the desired objectives.*

*Time has specifically been allocated for undertaking extra-curricular activities. Emphasis has been laid on developing and improving communication skills in the students for which Communication Lab has been introduced during the first year itself.*

*We hope that this revision will prove useful in producing competent diploma holders in the state of Himachal Pradesh. The success of this curriculum depends upon its effective implementation and it is expected that the managers of polytechnic education system in Himachal Pradesh will make efforts to create better facilities, develop linkages with the world of work and foster conducive and requisite learning environment.*

**Er. L.R. Rana**  
**Head(CCDC)**  
**Directorate of Technical Education,**  
**Vocational & Industrial Training,**  
**Sundernagar, Himachal Pradesh.**

## 3<sup>rd</sup> YEAR OF THREE YEAR DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

### 1. SALIENT FEATURES

- |                               |   |
|-------------------------------|---|
| 1) Name of the Programme :    | Three year Diploma Programme<br>Mechanical Engineering                    |
| 2) Duration of the Programme: | Three years (06 Semesters)  |
| 3) Entry Qualification :      | As prescribed by H.P. Takniki<br>Shiksha Board                            |
| 4) Intake :                   | As approved by H.P. Takniki<br>Shiksha Board                              |
| 5) Pattern of the Programme : | Semester Pattern  |
| 6) Curriculum for :           | 3 <sup>rd</sup> year of Three year Diploma<br>Programme(Technical Stream) |

#### 7) **Student Centred Activities:**

A provision of 2-4 hrs per week has been made for organizing Student Centred Activities for overall personality development of students. These activities will comprise of co-curricular & other activities such as expert lectures, games, seminars, declamation contests, educational field visits, NCC, NSS and cultural activities & hobby classes like photography, painting, singing etc.

## 2. GUIDELINES

### 2.1 GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

#### Distribution of 25 marks for SCA will be as follows:

i. 5 Marks shall be given for general behaviour

ii. 5 Marks for attendance shall be based on the following distribution:

1.	Less than 75%	Nil
2.	75-79.9%	3 Marks
3.	80-84.9%	4 Marks
4.	Above 85%	5 Marks

iii. 15 Marks shall be given for the Sports/NCC/Cultural and Co-curricular activities/other activities after due consideration to the following points:

1. For participation in sports/NCC/Cultural/Co-curricular activities at National or above level, shall be rewarded with minimum of 10 marks

2. For participation in sports/NCC/Cultural/Co-curricular activities at Inter-polytechnic level, shall be rewarded with minimum of 08 marks

3. For participation in two or more of the listed activities, 5 extra marks should be rewarded.

**Note:** *Head of Department shall ensure that these marks are conveyed to the H.P. Takniki Shiksha Board, Dharamshala at the end of semester along with sessional record.*

### 2.2 GUIDELINES FOR SESSIONAL ASSESSMENT

- The distribution of marks for Internal Assessment in theory subjects and drawing shall be made as per the following guidelines:
  - i. 60% of internal assessment shall be based on the performance in the tests. At least three tests shall be conducted during the semester out of which at least one should be house test. 30% weightage shall be given to house test and 30% to class test (One best out of two).
  - ii. 20% marks shall be given to home assignments, class assignments, seminars etc.
  - iii. 20% marks shall be given for attendance/punctuality in the subject concerned.
- The distribution of marks for Internal/External Assessment in practical subjects shall be made as per the following guidelines:
  - i. 60% marks shall be awarded for performance in practical.
  - ii. 20% marks shall be given for Report/Practical book and punctuality in equal proportion.
  - iii. 20% marks shall be for Viva-voce conducted during the practicals.
- The distribution of mark for internal assessment in drawing subjects shall be as per following guidelines:-
  - (i) 60% marks for sheets
  - (ii) 40% for test.

**FIFTH SEMESTER (MECHANICAL ENGINEERING)**

SR NO	SUBJECTS	STUDY SCHEME Hrs/Week		MARKS IN EVALUATION								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
5.1	Automobile Engineering	4	2	30	20	50	100	3	50	3	150	200
5.2	Machine Design	5	-	50	-	50	100	3	-	-	100	150
5.3	Production Planning and Control	4	-	50	-	50	100	3	-	-	100	150
5.4	Manufacturing Process-III	3	6	30	50	80	100	3	70	3	170	250
5.5	Elective-I 5.5.1 Mechatronics 5.5.2 Installation Testing & Maintenance 5.5.3 Foundry Technology 5.5.4 Welding Technology 5.5.5 Product Design & Development 5.5.6 Heat Treatment 5.5.7 Tool Engineering	4	3	30	20	50	100	3	50	3	150	200
5.6	*Generic Skills and Entrepreneurship Development	2	1	50	50	100	50	2	-	-	50	150
5.7	Industrial Training	-	-	-	50	50	-	-	50	-	50	100
5.8	Students Centred Activities	-	4	-	25	25	-	-	-	-	-	25
<b>Total</b>		<b>22</b>	<b>16</b>	<b>240</b>	<b>215</b>	<b>455</b>	<b>550</b>	<b>-</b>	<b>220</b>	<b>-</b>	<b>770</b>	<b>1225</b>

\* Common with other diploma programmes.

### SIXTH SEMESTER (MECHANICAL ENGINEERING)

SR. NO	SUBJECTS	STUDY SCHEME Hrs/Week		MARKS IN EVALUATION								Total Marks of Int. & Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
6.1	*Basics of Management	3	-	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	Metrology and Instrumentation	3	2	30	20	50	100	3	50	3	150	200
6.4	CAD	-	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	Project Work	-	8	-	100	100	-	-	100	3	100	200
6.7	*Practice in Communication Skills	-	2	-	50	50	-	-	50	3	50	100
6.8	Student Centred Activities	-	4	-	25	25	-	-	-	-	-	25
<b>Total</b>		<b>14</b>	<b>26</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>

\* Common with other diploma programmes.

## 5.1 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
  
- 2. Transmission System** (20 hrs)
  - 2.1 Clutch Function, Constructional details of single plate and multiplate friction clutches, Centrifugal and semi centrifugal clutch.
  - 2.2 Gear Box:Function, Working of slide mesh, constant mesh and synchromesh gear box, Torque converter and overdrive
  - 2.3 Propeller shaft and rear axleFunction, Universal joint, Differential, Rear axle drives and differenttypes of rear axles
  - 2.4 Wheels and Tyres  
Types of wheels- disc wheels and wire wheel, Types of tyres usedin 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, worm and roller, Rack and pinion type
  
- 4. Braking System** (06 hrs)
  - 4.1 Constructional detail and working of mechanical, hydraulic and vacuum brake.
  - 4.2 Details of master cylinder, wheel cylinder.
  - 4.3 Concept of brake drum, brake lining and brake adjustment.
  - 4.4 Bleeding of brakes
  
- 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** (04 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** (04 hrs)
- 7.1 Dynamo, Function and details, Regulators-voltage, current and compensated type, Cutout-Construction, working and their adjustment.
  - 7.2 Alternator, Construction and working, Charging of battery from alternator
- 8. 8.1 Diagram of a Typical Wiring System of a Vehicle.** (04 hrs)
- 8.2 Introduction to MPFI System.
- 9. Lighting System and Accessories** (04 hrs)
- 9.1 Lighting system
  - 9.2 Wiring circuit
  - 9.3 Headlight, aiming of headlights
  - 9.4 Lighting switches
  - 9.5 Direction Indicators
  - 9.6 Windscreen Wiper
  - 9.7 Horn
  - 9.8 Speedometer
  - 9.9 Heater
  - 9.10 Air-conditioning system
  - 9.11 Heavy duty vehicles (Tractors, Bulldozer, Forklift)

### **LIST OF PRACTICALS**

1. Study and sketch of
  - i) Head Light Model
  - ii) Wiper and Indicators
2. Study and sketch of
  - i) A.C. Pump
  - ii) S.U. Pump
  - iii) Master Cylinder
3. Study and sketch of
  - i) Rear Axle
  - ii) Differential
  - iii) Steering system
4. Engine tuning of an automobile engine
5. Driving practice of four wheeler
6. Charging of automobile battery and measuring cell voltage and specific gravity of electrolyte.
7. Study of Multi Point Fuel Injection and common Rank Diesel Injection System in Automobile.

8. Checking and adjusting of clutch pedal play and brake pedal play, tightness of fan belt and brake shoe.
9. Changing of wheels and inflation of tyres; alignment of wheels.
10. Measuring spark gap, valve clearance and ring clearance. Cleaning, grinding and lapping operations for adjustment.
11. Cleaning and adjusting a carburettor.
12. Nozzle cleaning, testing and adjustment.

#### **INSTRUCTIONAL STRATEGY**

1. Use Computer based learning aids for effective teaching
2. Expose students to real life problems
3. Plan assignments to promote problem solving abilities and to develop elementary driving knowledge.

#### **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.	06	15
5.	04	08
6.	04	10
7.	04	08
8.	04	08
9.	04	08
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.2 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.*

### DETAILED CONTENTS

1. **Introduction to Design** (06 hrs)
  - 1.1 Basic requirements for machine elements.
  - 1.2 General design process
  - 1.3 Mechanical properties
  - 1.4 General design considerations like fatigue, creep, fabrication methods, Economic considerations, material selection
  - 1.5 Designing for strength
  
2. **Riveted and Welded Joints** (12 hrs)
  - 2.1 Types of riveted joints
  - 2.2 Possible failure of riveted joints
  - 2.3 Strength and efficiency of riveted joints
  - 2.4 Common types of welded joints
  - 2.5 Simple design for V butt welded joint
  - 2.6 Transverse fillet and parallel fillet welded joint
  
3. **Screwed Joints** (15 hrs)
  - 3.1 Introduction to term screw and various definitions of screw threads
  - 3.2 Advantages and disadvantages of screwed joints.
  - 3.3 Form of screw threads
  - 3.4 Common types of screw fastening; through bolt, tap bolt, stud, cap screw, machine screw and set screws.
  - 3.5 Designation of screw threads
  - 3.6 Stresses in screw fastenings
  - 3.7 Design of bolts for cylinder cover
  
4. **Keys and Couplings** (13 hrs)
  - 4.1 Definition of term key; its various types.
  - 4.2 Splines
  - 4.3 Forces acting on sunk keys
  - 4.4 Shaft couplings and its various types
  - 4.5 Design of flange coupling
  
5. **Consumer Consideration in Design** (04 hrs)
  - 5.1 Ergonomics
  - 5.2 Need of Modern approach in Design
  - 5.3 Various factors of interaction between people and the world about them.

5.4 Design criteria for the following:

1. Displays
2. Controls

6. **Design of Cotter Joint for Round Rod** (10 hrs)

- 6.1 Design of cotter
- 6.2 Design of socket
- 6.3 Design of spigot

7. **Design of Knuckle Joint** (10 hrs)

- 7.1 Design of rod
- 7.2 Design of pin

### **INSTRUCTIONAL STRATEGY**

*While imparting instructions, the faculty should lay emphasis on concepts, derivations and numerical solutions. It should be supplemented with models, where ever possible.*

### **RECOMMENDED BOOKS**

1. *Machine Design by RS Khurmi and JK Gupta, Eurasia Publishing House Private Ltd., New Delhi.*
2. *Machine Design by VB Bhandari, Tata McGraw Hill, New Delhi.*
3. *Machine Design by RA Aggrawal, Nav Bharat Prakashion.*
4. *Machine Deisn by AP Verma, Katson Publishers*
5. *Machine Desing by Sharma and Aggrawal; Katson Publishers*
6. *Machine Design by JK Kapoor D Bharat Parkashan, Meerut.*

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>S.NO.</b>	<b>TIME ALLOTTED</b>	<b>Marks Allotted (%)</b>
1	06	11
2	12	15
3	15	18
4	13	16
5	04	10
6	10	15
7	10	15
<b>Total</b>	<b>70</b>	<b>100</b>

## 5.3 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** (06 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** (10 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, simple numerical problems.
  
- 4. Inventory Control** (08 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:** (07 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 expenses
  - 8.6 Cost control-capital cost control (planning and scheduling) operating cost control.

### **INSTRUCTIONAL STRATEGY**

*Efforts should be made to correlate the process of teaching with direct experiences in industry by use of computer based learning and Industrial visits.*

### **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	06	10
3	10	18
4	08	16
5	08	12
6	06	10
7	07	12
8	07	12
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.4 MANUFACTURING PROCESSES-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** (10 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** (06 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
- 5.5 Working principle of gear hobbing machine
- 5.6 Introduction to gear finishing operations

**6. Advanced Welding Techniques** (10 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. Practice in producing a rectangular block by milling.
- 2. To prepare a slot on one face of a job with a slotting cutter/ side and face cutter.
- 3. Exercise on milling machine with the help of a form cutter.
- 4. Exercise in cutting of serrations/ gears with the help of indexing device on a milling machine.
- 5. Exercises on press tools
- 6. Milling of a spur gear.
- 7. Fabrication of a job using inert gas welding.
- 8. Practice in welding stainless steel pieces.
- 9. Reclamation of worn-out part by metal spray and machining.
- 10. Practice in electroplating a component.

**11. INSTRUCTIONAL STRATEGY**

*Teacher should lay emphasis in making the students conversants with concepts, principles, procedures and practices related to various manufacturing processes.*

**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 Distributors.
- 3. *Production Technology* by HMT, Tata McGraw Publishers, New Delhi.

**SUGGESTED DISTRIBUTION OF MARKS**

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1	10	25
2	06	15
3	06	15
4	04	10
5	06	15
6	10	20
<b>Total</b>	<b>42</b>	<b>100</b>

## 5.5.1 MECHATRONICS

L T P

4 - 3

### 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 (03hrs)

- 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 (08hrs)

- 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 Liquid level sensors
- 2.8 Temperature sensors
- 2.9 Light sensors
- 2.10 Selection of sensors
- 2.11 Simple problems

#### 3. Data Presentation Systems (08hrs)

- 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 (08hrs)

- 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	
<b>5.</b>	<b>Mechanical Actuation Systems</b>	<b>(06hrs)</b>
5.1	Mechanical systems	
5.2	Cams	
5.3	Gear trains	
5.4	Ratchet and pawl	
5.5	Belt and chain drives	
5.6	Bearing	
5.7	Mechanical aspects of motor selection	
<b>6.</b>	<b>Electrical Actuation System</b>	<b>(06hrs)</b>
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	
<b>7.</b>	<b>Introduction to Digital Logic</b>	<b>(03 hrs)</b>
7.1	Digital logic	
7.2	Number systems	
7.3	Logic gates and their importance	
<b>8.</b>	<b>Microprocessors</b>	<b>(05 hrs)</b>
8.1	Control	
8.2	Microcomputer structure	
8.3	Microcontrollers	
8.4	Applications	
<b>9.</b>	<b>Input/output Systems</b>	<b>(06 hrs)</b>
9.1	Interfacing	
9.2	Input/output ports	
9.3	Interface requirements	
9.4	Peripheral interface adapters	
9.5	Serial communications interface	
9.6	Examples of interfacing	
9.7	Simple problems	
<b>10.</b>	<b>Programmable Logic Controllers</b>	<b>(03hrs)</b>
10.1	Programmable logic controllers- Applications	
10.2	Basic structure	
10.3	Input/output processing.	

### LIST OF PRACTICAL

1. Study on Mechanical drive, device, switches and system selection procedure and specific application.
2. Layout of temperature sensor circuit.
3. Study of water level control switch.
4. Study of strain gauge to measure the force up to 100 Newton.
5. Layout a circuit for door sensing and fabricate a door sensing system to sense and buzzer the calling bell.
6. Study and layout circuit of D.C. Shunt motor.
7. Study on stepper motor, layout a circuit for it.

### INSTRUCTIONAL STRATEGY

1. *Effort should be made to relate the actual application of various mechanical drives, device and switches in the modern manufacturing product.*
2. *Use of various electrical, electronic circuits, switches and devices in various electro-mechanical systems.*
3. *Students should be taken to industrial units for clear conception.*

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	03	07
2	08	12
3	08	12
4	08	12
5	06	10
6	06	14
7	03	05
8	05	10
9	06	12
10	03	06
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.5.2 INSTALLATION, TESTING & MAINTENANCE

L T P  
4 - 3

### RATIONALE

*A diploma engineer comes across installation, maintenance and testing of various machines and equipment in industries. The layout of different machines, their foundations is an important phenomenon of an industry. He should know the various methods of testing & maintenance. This subject will enable the diploma holders to deal with such aspects.*

### DETAILED CONTENTS

1. **Introduction** (04 hrs)
  - 1.1 Necessity of testing, repair and maintenance
  - 1.2 Economic aspects, manpower planning and materials management
  - 1.3 Fits and tolerances - common fits and tolerances used for various
  - 1.4 machine parts
2. **Execution and Commissioning of Machines (Installation)** (05 hrs)
  - 2.1 Location, layout and positioning of machines
  - 2.2 Foundation - types of foundation, foundation plan, erection and leveling, grouping, vibration damping, vibration isolation - methods of iso
3. **Inspection, Servicing, Repair & Overhauling of machines and equipment** (10 hrs)
  - 3.1 Inspection of various machines and equipment
  - 3.2 Servicing of various machines and equipment
  - 3.3 Repair of various machines and equipment
  - 3.4 Overhauling of various machines and equipment
  - 3.5 Recalibration of various measuring instruments, testing the speed of machines, accuracy of machines, alignment and performance of machines.
4. **Maintenance planning & stages of maintenance** (07 hrs)
  - 4.1 Maintenance planning
  - 4.2 Various stages of maintenance
  - 4.3 Maintenance schedules and record keeping
5. **Reliability Centred Maintenance** (03 hrs)
  - 5.1 Reliability
  - 5.2 Availability
  - 5.3 Maintainability
6. **Reliability Centred Maintenance** (03 hrs)
7. **Overhauling** (08 hrs)
  - 7.1 Frequent failure of common parts, their causes & remedial measures.
  - 7.2 Overhauling schedule and procedure.
  - 7.3 Parts which require frequent maintenance such as belts, couplings, nut, bolts, their repair & maintenance to avoid downtime.
  - 7.4 Fault diagnosis and action against fault. Examples of fault detection.

- 8 Maintenance** (08 hrs)
- 8.1 Meaning of maintenance, advantages & disadvantages
  - 8.2 Types of maintenance
  - 8.3 Preventive, predictive & breakdown maintenance.
  - 8.4 Maintenance organization.
  - 8.5 Centralized maintenance & decentralized maintenance.
  - 8.6 Computerization of maintenance.
  - 8.7 Greasing and lubrication schedule.

- 9 Storage of parts:** (08 hrs)
- 9.1 Storage of parts used frequently for replacement and parts which are not easily available in local market.
  - 9.2 History cards of different machines.
  - 9.3 Machines repair/replacement decision.

### LIST OF PRACTICALS

1. Preparation of prevention maintenance check.
2. Condition monitoring by NDT.
3. Study of maintenance of utility equipment like compressors, pumps, driers, and actuator type valves.
4. Equipment/machine leveling and alignment.
5. Maintenance of material handling equipment - pulley blocks, hand operated cranes, fork lifts, hydraulics jacks, mobile cranes, and winches.
6. Use of lubrication equipment like oil gun, grease gun.
7. Removing old lubricant, cleaning and replenishing and machine with fresh lubricant.
8. Visit to maintenance department of an industry & prepare a report

### INSTRUCTIONAL STRATEGY

*The emphasis to be laid on the actual study of maintenance of schedules. The use of Audio visual aids and computer based maintenance. The expert may be invited from the service and maintenance organizations.*

### RECOMMENDED BOOKS

1. *Industrial Maintenance by HP Garg; S. Chand and Company.*
2. *Plant Maintenance Engineering by RK Jain; Khanna Publishers.*
3. *A Text book of Reability and Maintenance Engineering by Dr. A Manna, Prentice Hall of India.*
4. *Installation, Servicing and Maintenance by SN Bhattacharya; S. Chand and Company.*
5. *Installation, Maintenance, Servicing by AR Basu; M Dutta and Co., Calcutta.*
6. *Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt., Ltd., New Delhi.*

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	04	10
2	05	10
3	10	20
4	07	10
5	03	05
6	03	05
7	08	14
8	08	14
9	08	12
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.5.3 FOUNDRY TECHNOLOGY

L T P  
4 - 3

### **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 cas processes and developments in this area.*

### **DETAILED CONTENTS**

- 1. PATTERN MAKING** (5hrs)
  - 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** (5hrs)
  - 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** (3hrs)
  - 3.1 Mould, drying
  - 3.2 Core Drying
  - 3.3 Defects
  
- 4 MELTING PRACTICE** (7hrs)
  - 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** (3hrs)
- 5.1 Coring up, venting and closing
  - 5.2 Ladles, pouring
- 6 SOLIDIFICATION OF CASTING** (7hrs)
- 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** (7hrs)
- 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** (7hrs)
- 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** (4hrs)
- 9.1 Stress relief and annealing
  - 9.2 Treatments involving rapid cooling
  - 9.3 Defects caused by heat treatment
- 10 MODERNIZATION OF FOUNDRIES** (8hrs)
- 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.*

**PRACTICAL EXERCISES**

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.

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	05	10
2	05	10
3	03	08
4	07	10
5	03	08
6	07	12
7	07	10
8	07	12
9	04	08
10	08	12
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.5.4 WELDING TECHNOLOGY

L T P

4 - 3

### **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. The subject aims at development of knowledge and skills in the area of welding techniques, both conventional and modern.*

### **DETAILED CONTENTS**

- 1. INTRODUCTION TO WELDING** (5hrs)
  - 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** (7hrs)
  - 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** (7hrs)
  - 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** (7hrs)
- 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** (9hrs)
- 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** (5hrs)
- 6.1 Principle
  - 6.2 Procedure
  - 6.3 Brazing filler alloys
  - 6.4 Brazing fluxes
  - 6.5 Advantages, Limitations and applications
- 7 **SOLDERING** (5hrs)
- 7.1 Principle
  - 7.2 Solders
  - 7.3 Soldering fluxes
  - 7.4 Soldering Methods
  - 7.5 PCB Soldering
- 8 **WELDING OF DIFFERENT MATERIALS** (5hrs)
- 8.1 Welding Cast iron, Alloy Steel, tool Steel, Aluminium, Magnesium, Stainless, Copper
- 9 **WELD DEFECTS AND TESTING** (6hrs)
- 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.

### **PRACTICAL EXERCISES**

1. Setting of flame length and colour for welding
2. Preparation metal edges for welding
3. Gauging practice
4. Setting of appropriate current and voltage for thin and thick work pieces, electrodes selection.
5. Practice of Tacking
6. Practice of vertical and overhead welding
7. Practice of forward and backward welding
8. Practice of welding pipes by electric arc welding technique.
9. Practice of Soldering
10. Rectification of welding defects in plates and pipe jobs
11. Welding Practice for lap welding and Butt welding.

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	05	10
2	07	12
3	07	12
4	07	12
5	09	14
6	05	10
7	05	10
8	05	10
9	06	10
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.5.5 PRODUCT DESIGN AND DEVELOPMENT

L T P  
4 - 3

### Rationale:

*Diploma holders in Mechanical Engineering are to provide professional assistance in design and development of prototypes, tools, jigs and fixtures. For this purpose, it is essential to impart knowledge and skills about ergonomics, engineering design, decision making and computer aided design for enabling them to perform functions.*

### DETAILED CONTENTS

1. **ERGONOMICS** (8 hrs)
  - 1.1 Introduction
  - 1.2 Application
  - 1.3 Approaches and models in ergonomics.
  - 1.4 Design of displays and controls.
  - 1.5 Layout of panels.
  
2. **DESIGN ACTIVITIES** (4 hrs)
  - 2.1 Stage of product development
  - 2.2 Feasibility study and product life cycle
  
3. **ELEMENTS OF ENGINEERING DESIGN** (8 hrs)
  - 3.1 Major phases of design
  - 3.2 Design codes and standards.
  - 3.3 Factor of safety and derating factor
  - 3.4 Modelling in design
  
4. **GENERAL CONSIDERATIONS IN MECHANICAL DESIGN** (11hrs)

Various considerations such as function environment, life, reliability, safety, maintenance, cost, quantity manufactures, patents, appearance, packing, limits, fits and tolerances.
  
5. **DECISION MAKING**
  - 5.1 Decision matrix (4 hrs)
  - 5.2 Decision trees
  
6. **DESIGN OF MANUFACTURING** (11 hrs)
  - 6.1 Design considerations for cast components
  - 6.2 Design considerations for forged components
  - 6.3 Design of Sheet metal parts
  - 6.4 Design involving joining processes
  - 6.5 Design involving machining process.
  
7. **COMPUTER AIDED DESIGN** (10 hrs)
  - 7.1 Components of CAD Systems
  - 7.2 Application of Computer for design
  - 7.3 Benefit of CAD
  - 7.4 Hardware and software in CAD
  - 7.5 Function of graphics package
  - 7.6 Simple computer Aided Drafting Exercise

**Note:-**

*\* An expert from some industry may be invited for the lecture.*

**PRACTICAL EXERCISES**

1. Ergonomic study and analysis of displays and control in a car/ automobile
2. Conducting a feasibility study of a consumer product
3. Collecting information on an Engineering product and suggesting improvement.
4. Case study of a product development
5. Making 2D working drawing with the help of computer software (like AUTOCAD , ROBOCAD, DRAFTPAC, MICROSTATION PC etc.)

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted(%)</b>
1	08	12
2	04	10
3	08	13
4	11	15
5	04	10
6	11	20
7	10	20
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.5.6 HEAT TREATMENT

L T P  
4 - 3

### RATIONALE

*Heat Treatment is the process through which it is possible to bring the desired changes in material properties. Diploma holders in Mechanical Engineering are required to select material by various products. Therefore they should have knowledge about various heat treatment processes. This subjects aims at development of knowledge and skill about concept of Heat treatment, various processes and Heat treatment of tools and machine.*

### DETAILED CONTENTS

1. **SOLIDIFICATION OF IRON** (4 hrs)
  - 1.1 Grain Structure
  - 1.2 Nucleation and grain size.
  - 1.3 Formation of Dendrites
  - 1.4 Directional solidification.
  
2. **IRON-CARBON EQUILIBRIUM DIAGRAM** (4hrs)
  - 2.1 Various constituent phases.
  - 2.2 Advantages of Equilibrium Diagram.
  
3. **TTT CURVE** (4 hrs)
  - 3.1 Study of TTT Curve
  - 3.2 Its specifies application in Heat treatment of steel and phase transformation.
  
4. **HEAT TREATMENT** (4 hrs)
  - 4.1 Concept and purpose
  - 4.2 Allotropic forms of iron.
  
5. **TYPICAL HEAT TREATMENT PROCESSES FOR STEEL** (7 hrs)
  - 5.1 Annealing
  - 5.2 Normalizing
  - 5.3 Hardening
  - 5.4 Tempering
  - 5.5 Hardanability-only concept.
  - 5.6 Different colours and temperatures.
  - 5.7 Austempering
  - 5.8 Mar tempering
  
6. **SURFACE HARDENING** ( 7hrs)
  - 6.1 Objectives and uses
  - 6.2 Flame hardening
  - 6.3 Induction hardening
  - 6.4 Surface hardening in an electrolytic bath
  - 6.5 Cooling Medium and their effects on cooling rate.
  
7. **CASE HARDENING OF STEEL** ( 4hrs)
  - 7.1 Essence an fundamentals of case hardening
  - 7.2 Carbursing



- 7.3 Nitriding
- 7.4 Cyaniding
- 8. **HEAT TREATMENT FURNANCE** (4 hrs)
  - 8.1 Muffle, induction and salt bath furnaces
- 9. **HEAT TREATMENT OF TOOLS** (5 hrs)
  - 9.1 Heat Treatment of high carbon steel tools
  - 9.2 Heat treatment of high speed cutting tools
  - 9.3 Heat treatment of hammer dies and die moulds.
- 10. **HEAT TREATMENT OF MACHINE PARTS** (8hrs)
  - 10.1 Heat Treatment of steel casting
  - 10.2 Heat Treatment of forgings of shafts and axles
  - 10.3 Heat treatment of springs
  - 10.4 Heat treatment of gears
- 11. **FINISHING OPERATIONS AFTER HEAT TREATMENTS** (5 hrs)
  - 11.1 Removal of scale
  - 11.2 Alkaline-detergent cleaning and degreasing
  - 11.3 Straightening

**PRACTICAL EXERCISES**

1. Study and understanding of various types of furnaces and their uses.
2. Study and understanding of temperature measuring devices. Their locations and various types of devices used.
3. Study and sketching of various hand tools, lifting tackles, gadgets used.
4. Study and sketch of various types of quenching tanks and methods of agitation.
5. Practical work on heat treatment of small tool dies, trimming dies, coining tools and forging dies.
6. Practicals work on heat treatment of forged components and mass produced items.
7. Practicals on tempering, pack carburising, cyaniding, gas carburising.
8. Hardness testing of tools and dies and correlating the results on other hardness testers.

**SUGGESTED DISTRIBUTION OF MARKS**

Topic No	Time Allotted (hrs)	Marks Allotted (%)
1	4	8
2	4	8
3	4	8
4	4	8
5	7	12
6	7	12
7	4	8
8	4	8
9	5	8
10	8	12
11	5	8
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.5.7 TOOL ENGINEERING

L T P

4 - 3

### 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 equipments remain in working order. For this purpose, knowledge about jigs and fixture, press tools and other tooling equipments is essential. Hence this subjects. The subjects aims at development of knowledge and skills regarding press tools, jigs & Fixtures and other equipments for increased productivity and quality.*

### DETAILED CONTENTS

- 1. CUTTING TOOLS MATERIALS** (8 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** (20 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.

**PRACTICAL EXERCISES**

- 1. Sketch of a single point cutting tool geometry.
- 2. Design and drawing of a drill jig for a given components.
- 3. Design and drawing of a plain milling fixtures for a given job.
- 4. Making a cut off tool and drawing tool.
- 5. Making and drawing of blanking and trimming tool.
- 6. Drawing of compound press tool.
- 7. Drawing of general arrangement of progressive press tools.
- 8. Visits to an industry engaged in mass production. Various tools, jigs and fixtures and press tools to be shown to the students during the operations.

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (hrs)</b>	<b>Marks Allotted (%)</b>
1	08	15
2	20	40
3	28	45
<b>Total</b>	<b>56</b>	<b>100</b>

## 5.6 GENERIC SKILLS & ENTREPRENEURSHIP DEVELOPMENT

L T P  
2 - 1

### 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 employability or generic 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, "generic skills 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 Generic Skills (02 Hrs)**
  - 1.1 Concept and importance
  - 1.2 Local and global scenario
  - 1.3 Concept of life-long learning (LLL)
  
- 2. Self Management and Development (07 Hrs)**
  - 2.1 Concept of Personality Development, Ethics and Moral values
  - 2.2 Concept of Intelligence and Multiple intelligence Types viz, linguistic, mathematical & Logical reasoning, emotional, and social intelligence (interpersonal & intrapersonal).
  - 2.3 Concept of Physical Development; significance of health, hygiene, body gestures & kinesics.
  - 2.4 Time Management concept and its importance
  - 2.5 Intellectual Development; reading skills (systematic reading, types and SQ5R), 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).
  - 2.6 Psychological Management; stress, emotions, anxiety and techniques to manage these.
  - 2.7 ICT & Presentation skills; use of IT tools for good and impressive presentations.
  
- 3. Team Management (03 Hrs)**
  - 3.1 Concept of Team Dynamics. Team related skills such as; sympathy, empathy, leading, coordination, negotiating and synergy. Managing cultural, social and ethnic diversity.
  - 3.2 Effective group communication and conversations.
  - 3.3 Team building and its various stages like forming, storming, norming, performing and adjourning (Bruce Tuckman's five stage Model)
  
- 4. Project Management (02 Hrs)**
  - 4.1 Concept of Management and features

- 4.2 Stages of Project Management; initiation, planning, execution, closing and review (through case studies)
- 4.3 SWOT analysis concept.
- 5. Introduction to Entrepreneurship (02 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, limited, public limited, PPP mode.
- 5.3 Types of industries viz, micro, small, medium and large
- 6. Entrepreneurial Support System (features and roles in brief) (03 Hrs)**  
District Industry Centres (DIC's), State Financial Corporation's (SFC's), Small Industries Service Institutes(SISI), Commercial Banks, Micro Financing Institutions, SIDBI, NABARD, National Small Industry Corporations (NSIC), Cooperative Societies and Venture Capitalists. Various Consultancy Organizations; HIMCON, Khadi and Gramodyog Board (H.P.) etc.
- 7. Market Study and Opportunity Identification (04 Hrs)**  
Types of study; primary and secondary, product or service identification, assessment of demand and supply, type of surveys and important features; qualitative, empirical, schedules, questionnaire, interview.
- 8. Project Report Preparation (05 Hrs)**
- 8.1 Preliminary Report, Techno-Economic Feasibility Report, Detailed Project Report (DPR) and illustration of these through examples.
- 8.2 Exercises on writing project reports of micro and small projects.

### List of Practical Exercises

1. *Understanding Self Management and Development (Related to Chapter 02); through examples, cases, exercises, panel discussions, seminars, meditation and yoga techniques.*
2. *Team Management (Related to chapter 03); through examples, cases, role plays, group discussions and panel discussions.*
3. *Market Study and Opportunity Identification (Related to Chapter 07); through literature reviewing, making questionnaires, conducting mock interviews and analysing data for product/service identification and demand assessment.*
4. *Project Management and Project Report Preparation (Related to chapter 04 and 08); through exercises on making project reports on micro and small enterprises. Case studies and SWOT analysis of projects can be taken.*

### Instructional Strategy

*Since the emphasis of present training need and work requirements is on budding entrepreneurs as well as intelligent and multi skilled work force. Therefore skill development and knowledge imparting should be focussed on generic and entrepreneurial skill development. Thus instructional strategy of the subject should be more practical oriented and theories must be taught up to conceptual or informal levels. Different methodologies may be used with inclusive approach and must be supported with different training tools such as group and panel discussions , role plays, case studies, field surveys through questionnaires, schedules and interviews, presentations, seminars and expert talks in practical lectures and through student centred activities. Students may also be provided with extracted study material and handouts too.*

### 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. *Human Learning, Ormrod*
5. *What Work Requires of Schools? SCANS Report: U.S. Department of Labour*
6. *Entrepreneurship Development by CB Gupta and P Srinivasan: Sultan Chand and sons: New Delhi*
7. *Entrepreneurship Development by S. L. Gupta and Arun Mittal: IBH Publication*
8. *A Handbook of Entrepreneurship, Edited by B S Rathore and Dr. J S Saini*
9. *Entrepreneurship Development and Small Business Enterprises by Poornima M: Pearson Education India*
10. *Handbook of Small Scale Industry by P M Bhandari*

### Inspirational Books

1. *Stay Hungry stay Foolish by Rashmi Bansal*
2. *An Autobiography by Lee Iacocca*
3. *Steve Jobs: The Biography by Walter Isaacson*

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs.)	Marks Allotted %
1	2	7
2	7	26
3	3	10
4	2	7
5	2	10
6	3	10
7	4	15
8	5	15
<b>Total</b>	<b>28</b>	<b>100</b>

## 6.1 BASICS OF MANAGEMENT

L T P  
3 - -

### RATIONALE

*Since the diploma holders are expected to take up middle level managerial positions, their exposure to basic management principles is very essential. Some topics like Structure of Organization, Leadership, Motivation, Customer Relationship Management (CRM), Legal Aspects of Business, Environmental Considerations, Accident and Safety: Total Quality Management (TQM), Intellectual Property Rights (IPR) etc. have been included in the subject.*

### DETAILED CONTENTS

1. **Introduction:** (12 hrs)  
Definition and concept of management, functions of management- planning, organizing, staffing, coordinating and controlling. Various areas of management-
  - (a) Human Resource Management(HRM)-Manpower recruitment and selection, induction , training and development and performance appraisal.
  - (b) Financial Management- Meaning of financial management, its importance, various sources of finance- long term and short term. Concept of Internal Rate of Return(IRR), Net Present Value (NPV) and Average Rate of Return.
  - (c) Marketing Management- Product life cycle, concept of pricing, promotion strategies- advertising, sales promotion and market research.
  - (d) Material Management – Inventory management, concept of economic order quantity and waste management.
  
2. **Structure and Ownership of Organization:** (04 hrs)  
Concept and structure of an organization, hierarchical management structure (top, middle and lower level management), functional management structure and matrix organizational structure. Types of business ownership (salient features)- Sole Proprietorship, Partnership, Joint Stock Companies and Cooperative Ownership.
  
3. **Leadership:** (02 hrs)  
Meaning, importance , types of leadership and qualities of a good leader.
  
4. **Motivation:** (04 hrs)  
Concept and importance of motivation- drives and incentives, types of motivation and theories of motivation- Abharam Maslow Theory and Herzberg Two Factor Theory.
  
5. **Customer Relationship Management:** (04hrs)  
Need, various types of customers, customer satisfaction, Customer Satisfaction Index(CSI) and its significance in playing effective role of engineers in changing scenario.

- 6. Legal Environment and Business:** (08 hrs)
- 6.1 Various labour laws and its necessity. Salient features of Income Tax Act – Computation of income tax on salary income, Sales and Excise Tax Act-VAT & Excise duty and Factory Act. 1948.
- 6.2 Labour Welfare Schemes including wage payment-types, system of wage payment and incentives.
- 6.3 Intellectual Property Rights(IPR)- Concepts, infringements and remedies related to patents, copy rights, trademarks and designs.
- 6.4 Accident and Safety- Meaning and concept of accident and safety, causes, safety precautions and various measures after accidents.
- 7. Total Quality Management:** (04 hrs)
- Meaning and concept of Total Quality Management(TQM), various factors/measures to achieve TQM in an organization. Standards and Codes-National & International.
- 8. Environmental Management:** (04 hrs)
- Concept of ecology and environment, factors contributing to air pollution, water pollution and noise pollution. Different measures to control pollution. Disaster management-features and measures.

### INSTRUCTIONAL STRATEGY

*It is observed that the diploma holders generally take up middle level managerial positions, therefore, their exposure to basic management principles is very essential. Accordingly students may be given conceptual understanding of different topics related to management. Some of the topics may be taught using question answer, assignment or seminar. The teacher will discuss success stories and case studies with students, which in turn, will develop appropriate managerial qualities in the students. In addition, expert lectures may also be arranged from within the institutions or from management organisations. Appropriate extracted reading material and handouts may be provided.*

### RECOMMENDED BOOKS

1. *Principles of Management by Philip Kotler TEE Publication*
2. *Principles and Practice of Management by ShyamalBannerjee: Oxford and IBM Publishing Co, New Delhi.*
3. *Financial Management by MY Khan and PK Jain, Tata McGraw Hill Publishing Co.: 7, West Patel Nagar , New Delhi.*
4. *Modern Management Techniques by SL Goel: Deep and Deep Publications Pvt Limited , Rajouri Garden, New Delhi.*
5. *Management by James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr. : Prentice Hall of India Pvt Ltd, New Delhi.*
6. *Essentials of Management by H Koontz, C O' Daniel , Mc Graw Hill Book Company, New Delhi.*
7. *Marketing Management by Philip Kotler, Prentice Hall of India, New Delhi*
8. *Total Quality Management by Dr DD Sharma, Sultan Chand and Sons, New Delhi.*
9. *Intellectual Property Rights and the Law by Dr. GB Reddy.*
10. *Service Quality Standards, Sales & Marketing Department, MarutiUdyog Ltd.*
11. *Customer Relationship Management: A step-by-step approach, Mohamed & Sagadevan Oscar Publication, Delhi*
12. *Customer Relation Management, Sugandhi RK, Oscar Publication, Delhi*
13. *Environment Engineering by GN Pandey & GC Pandey, Tata McGraw Hill Publication.*



### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1	12	15
2	04	10
3	02	10
4	04	12
5	04	10
6	08	15
7	04	08
8	04	20
<b>Total</b>	<b>42</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** (07 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** (09 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** (07 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** (07 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. Psychrometry** (07 hrs)
- 5.1 Various terms-Dry and wet bulb temperatures, Saturation, Dewpoint, adiabatic saturation, temperature, Relative humidity, absolute humidity, humidity ratio.
  - 5.2 Psychrometric chart and its uses
  - 5.3 Psychrometric processes-Sensible heating and sensible cooling, humidification and dehumidification, cooling and dehumidification, heating and humidification, and their representation on psychrometric chart.
  - 5.4 Simple Problems
- 6. Airconditioning** (05 hrs)
- 6.1 Introduction
  - 6.2 Metabolism in human body
  - 6.3 Human comfort
  - 6.4 Applications of air-conditioning
- 7. Heat Loads** (05 hrs)
- 7.1 Various types of loads
  - 7.2 Sensible and latent heat load
  - 7.3 Load calculations
- 8. Airconditioning System** (05 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.

## INSTRUCTIONAL STRATEGY

- While imparting instructions, focus should be on conceptual understanding.
- Emphasis on use of Audio Visual aids should be given

## RECOMMENDED BOOKS

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

## SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allotted(%)
1	07	12
2	09	15
3	07	12
4	07	12
5	07	15
6	05	10
7	05	12
8	05	07
9	04	05
<b>Total</b>	<b>56</b>	<b>100</b>

## 6.3 METROLOGY AND INSTRUMENTATION

L T P  
3 - 2

### RATIONALE

*Metrology is the science of measurement. Diploma holders in Mechanical Engineering are responsible for ensuring process control and quality control by making measurements and inspection of various parameters. For this purpose, knowledge and skills about various measuring instruments is required. Hence this subject. The aim of this subject is to develop knowledge and skills regarding various measuring instruments amongst the students.*

### DETAILED CONTENTS

- |   |          |
|---|----------|
| <b>1. Introduction</b>  | (03 hrs) |
| 1.1 Meaning of metrology  |          |
| 1.2 Precision and accuracy  |          |
| 1.3 Interchangeability  |          |
| <b>2. Linear Measurements</b>                                       | (08 hrs) |
| 2.1 Working principle and constructional details of:-               |          |
| 2.2 Engineering scale   |          |
| 2.3 Vernier Caliper   |          |
| 2.4 Micrometer  |          |
| 2.5 Height gauge and depth gauge                                    |          |
| 2.6 Radius gauge and feeler gauge                                   |          |
| 2.7 Dial indicator  |          |
| 2.8 Comparators ( In general use only)                              |          |
| 2.9 Slip Gauges   |          |
| <b>3. Angular Measurements</b>                                      | (07 hrs) |
| 3.1 Working principle and constructional details of:-               |          |
| 3.2 Combination set   |          |
| 3.3 Vernier bevel protractor  |          |
| 3.4 Sine bar  |          |
| 3.5 Taper measurement by rollers                                    |          |
| <b>4. Surface Measurements</b>                                      | (03 hrs) |
| 4.1 Straight edge   |          |
| 4.2 Try square  |          |
| 4.3 Surface plate( Use and specifications)                          |          |
| <b>5. Limit Gauges</b>  | (02 hrs) |
| GO and NO GO gauges   |          |
| <b>6. Thread Measurements</b>                                       | (03 hrs) |
| 6.1 Measurement of thread elements of external and internal threads |          |
| 6.2 Screw pitch gauge   |          |
| 6.3 Screw thread Micrometer   |          |
| 6.4 Thread limit Gauges   |          |

**7. Gear Tooth Vernier** (02 hrs)

**8. Surface Finish Measurements** (04 hrs)

8.1 Roughness and Waviness Various roughness values-CLA value, RMS Value, Mean value.

8.2 Surface roughness measuring instrument- principle of working

**9. Other Measuring Instruments** (04 hrs)

9.1 Autocollimator

9.2 Tool maker's Microscope

9.3 Profile Projector

9.4 Coordinate Measuring Machine

**10. Instrumentation** (06 hrs)

10.1 Measurement of Mechanical quantities such as displacement, vibrations, frequency, pressure, temperature, humidity by electromechanical transducers of resistance, capacitance and inductance type.

### **LIST OF PRACTICALS**

1. Use of linear measuring instruments like vernier caliper and micrometer.
2. Use of height gauge and depth gauge.
3. Measurements with the help of combination set and bevel protractor.
4. Angle measurement by use of sine bar and slip gauges.
5. Use of slip gauges in measurement of centre distance between two pins.
6. Use of comparator for measurement.
7. Measurement of taper by standard balls and rollers.
8. Measurement of thread parameters by using Tool makers microscope.
9. Measurement of gear elements by using gear tooth vernier.
10. Measurement of profile by profile projector.
11. Measurement of surface roughness of a surface.

### **INSTRUCTIONAL STRATEGY**

- *Demonstrate use of various measuring instruments while imparting theoretical instructions.*
- *Stress should be on correct use of various instruments.*

## RECOMMENDED BOOKS

1. *Engineering Metrology* by R.K. Jain, Khanna Publishers
2. *A Text Book of Production Engineering* by P.C Sharma
3. *Engineering Metrology* by R.K. Rajput; S.K. Kataria & Sons

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs.)	Marks Allotted(%)
1	03	05
2	08	15
3	07	10
4	03	10
5	02	10
6	03	10
7	02	05
8	04	10
9	04	10
10	06	15
<b>Total</b>	<b>42</b>	<b>100</b>

## 6.4 COMPUTER AIDED DRAFTING

L T P

- - 4

### RATIONALE

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

### LIST OF PRACTICALS

#### 1. Introduction to CAD commands

- 1.1 Concept of CAD, Tool bars in CAD, coordinate system, snap, grid, and ortho mode
- 1.2 Drawing commands - point, line, arc, circle, ellipse,
- 1.3 Editing commands - scale, erase, copy, stretch, lengthen and explode.
- 1.4 Dimensioning and placing text in drawing area
- 1.5 Sectioning and hatching
- 1.6 Inquiry for different parameters of drawing entity

#### 2. Detail and Assembly drawing of the following using CAD

- 2.1 Journal Bearing
- 2.2 Wall Bracket
- 2.3 Stepped pulley, V-belt pulley
- 2.4 Flanged coupling
- 2.5 Spur gear
- 2.6 Screw jack

#### 3. Isometric Drawing by CAD

Drawings of following on computer:

- Cone
- Cylinder
- Isometric view of objects

#### 4. Modelling

3D modelling, Transformations, scaling, rotation, translation

#### 5. Introduction to other CAD softwares

(Pro Engineer or CATIA/NX4 as NX5/Solid Edge/Ideas) : Salient features, simple drawing of components (2 D and 3D)

### INSTRUCTIONAL STRATEGY

1. Teachers should show model or realia of the component/part whose drawing is to be made.
2. Emphasis should be given on cleanliness, dimensioning and layout of sheet.
3. Teachers should ensure use of IS codes related to drawing.



## **RECOMMENDED BOOKS**

1. *Engineering Drawing with AutoCAD 2000* by T. Jeyapooran; Vikas Publishing House, Delhi.
2. *AutoCAD for Engineering Drawing Made Easy* by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
3. *AutoCAD 2000 for you* by UmeshShettigar and Abdul Khader; Janatha Publishers, Udupi.
4. *Auto CAD 2000* by Ajit Singh, TMH, New Delhi.
5. *Designing with Pro Engineer*, Sham Tickoo by Dream Tech Publications, New Delhi.
6. *Designing with CATIA*, by Sham Tickoo, Dream Tech. Publications, New Delhi.
7. *Designing with NX4 or Solid Edge* by Shamtickoo

## 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** (07 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** (14 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** (07 hrs)  
Introduction, various cutting tools for CNC machines, Work holding devices, automatic tool changer.
4. **Control System** (09 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** (09 hrs)  
Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using canned cycles, subroutines and do loops, tool off set cutter radius compensation and wear compensation

6. **Common Problems in CNC Machines** (05 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** (05 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. Develop a part programme for following lathe operations and make the job on CNC lathe
  - 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.

## **INSTRUCTIONAL STRATEGY**

*This is highly practice-based course. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.*

## **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**

<b>Topic</b>	<b>Time Allotted(Hrs.)</b>	<b>Marks Allotted (%)</b>
1	07	12
2	14	28
3	07	12
4	09	16
5	09	16
6	05	08
7	05	08
<b>Total</b>	<b>56</b>	<b>100</b>

## 6.6 MAJOR PROJECT

L T P  
- - 8

### RATIONALE

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.
- v) 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 project work should match with the competency profile of students and the project work assigned to them. Students may be assessed both by industry and polytechnic faculty. The suggested performance criteria is given below :

- (1) Punctuality and regularity
- (2) Initiative in learning/working at site
- (3) Level/proficiency of practical skills acquired
- (4) Ability of solve live practical problems
- (5) Sense of responsibility
- (6) Self expression/communication skills
- (7) Interpersonal skills/Human Relation
- (8) Report Writing Skills
- (9) 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:

1. Projects connected with repair and maintenance of machine parts.
2. Estimating and costing projects
3. Design of components/parts/jigs/fixtures.
4. Projects related to quality control.
5. Project work related to increasing productively.
6. Project connected with work study.
7. Projects relating to erection, installation, calibration and testing.
8. Projects related to wastage reduction.
9. Problem related to value analysis/value engineering
10. Project related to mistake proofing.

## 6.7 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 PRACTICAL EXERCISES**

1. Exercises on phonetics
2. Group Discussion
3. Exercises on self-assessment using tools like SWOT analysis.
4. Internet communication
5. Correspondence
  - 5.1 Resume writing
  - 5.2 Covering letter
  - 5.3 Follow-up correspondence
  - 5.4 Business Correspondence
6. Practice on listening skills.
7. Speaking exercises with emphasis on voice modulation (reading and extempore)
8. Demonstration and practice on Body language and Dress sense.
9. Exercises on etiquettes and mannerism in difficult situations like businessmeetings, table manners, telephone etiquette and manners related to opposite gender.
10. Mock interviews (telephonic/personal)
11. Cross-cultural Communication
12. Role play for effective Communication.
13. Exercises on wit and humour in conversations and creating lively environment.