 <b>MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</b> <b>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</b>																
<b>COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING</b>																
<b>COURSE CODE : ME</b>																
<b>DURATION OF COURSE : SIXTH SEMESTERS</b>										<b>WITH EFFECT FROM 2009-10</b>						
<b>SEMESTER : SIXTH</b>										<b>DURATION: 16 WEEKS</b>						
<b>PATTERN : FULL TIME - SEMESTER</b>										<b>SCHEME : E</b>						
SR. NO.	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									
				TH	TU	PR	PAPER HRS	TH (01)		PR (04)		OR (08)		TW (09)		SW (16006)
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
1	Management Ø	MAN	12219	03	--	--	03	100	40	--	--	--	--	--	--	
2	Design of Machine Elements	DME	12241	04	--	02	04	100	40	--	--	25#	10	25@	10	
3	Industrial Fluid Power \$	IFP	12242	04	--	02	03	100	40	--	--	25#	10	25@	10	
4	Production Technology \$	PTE	12243	04	--	--	03	100	40	--	--	--	--	--		
5	Industrial Project \$	IPR	12248	--	--	06	--	--	--	--	--	50#	20	50@	20	
6	Professional Practices - VI \$	PPS	12249	--	--	05	--	--	--	--	--	--	--	50@	20	
7	<b>ELECTIVE – II (Any One)</b>															
	Alternate Energy Sources & Management \$	AES	12244	03	--	02	03	100	40	--	--	--	--	25@	10	
	Material Handling Systems	MHS	12245	03	--	02	03	100	40	--	--	--	--	25@	10	
	Refrigeration & Air-Conditioning	RAC	12246	03	--	02	03	100	40	--	--	--	--	25@	10	
	CAD-CAM & Automation	CCA	12247	03	--	02	03	100	40	--	--	--	--	25@	10	
<b>TOTAL</b>				<b>18</b>	<b>--</b>	<b>17</b>	<b>--</b>	<b>500</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>175</b>	<b>--</b>	<b>50</b>
Student Contact Hours Per Week: <b>35 Hrs.</b>																
<b>THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.</b>																
Total Marks : <b>825</b>																
@ Internal Assessment, # External Assessment, <span style="background-color: #cccccc; padding: 2px;">      </span> No Theory Examination, \$- Common to ME/PG/PT/MH/MI, Ø - Common to ME/PT/AE/MH/FE																
Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Termwork, SW- Sessional Work.																
<ul style="list-style-type: none"> <li>➤ Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW).</li> <li>➤ Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.</li> <li>➤ Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.</li> </ul>																

**Course Name : All Branches of Diploma in Engineering / Technology**

**Course Code : EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/CO/CM/IF/EE/EP/CH/CT/PS/CD/ED/EI/CV/FE/IU/MH/MI/TX/TC**

**Semester : Sixth for EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/CO/CM/IF/EE/EP/CH/CT/PS/TX/TC and Seventh for MH/MI/CD/ED/EI/CV/FE/IU**

**Subject Title : Management**

**Subject Code : 12219**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	--	03	100	--	--	--	100

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

**Rationale:**

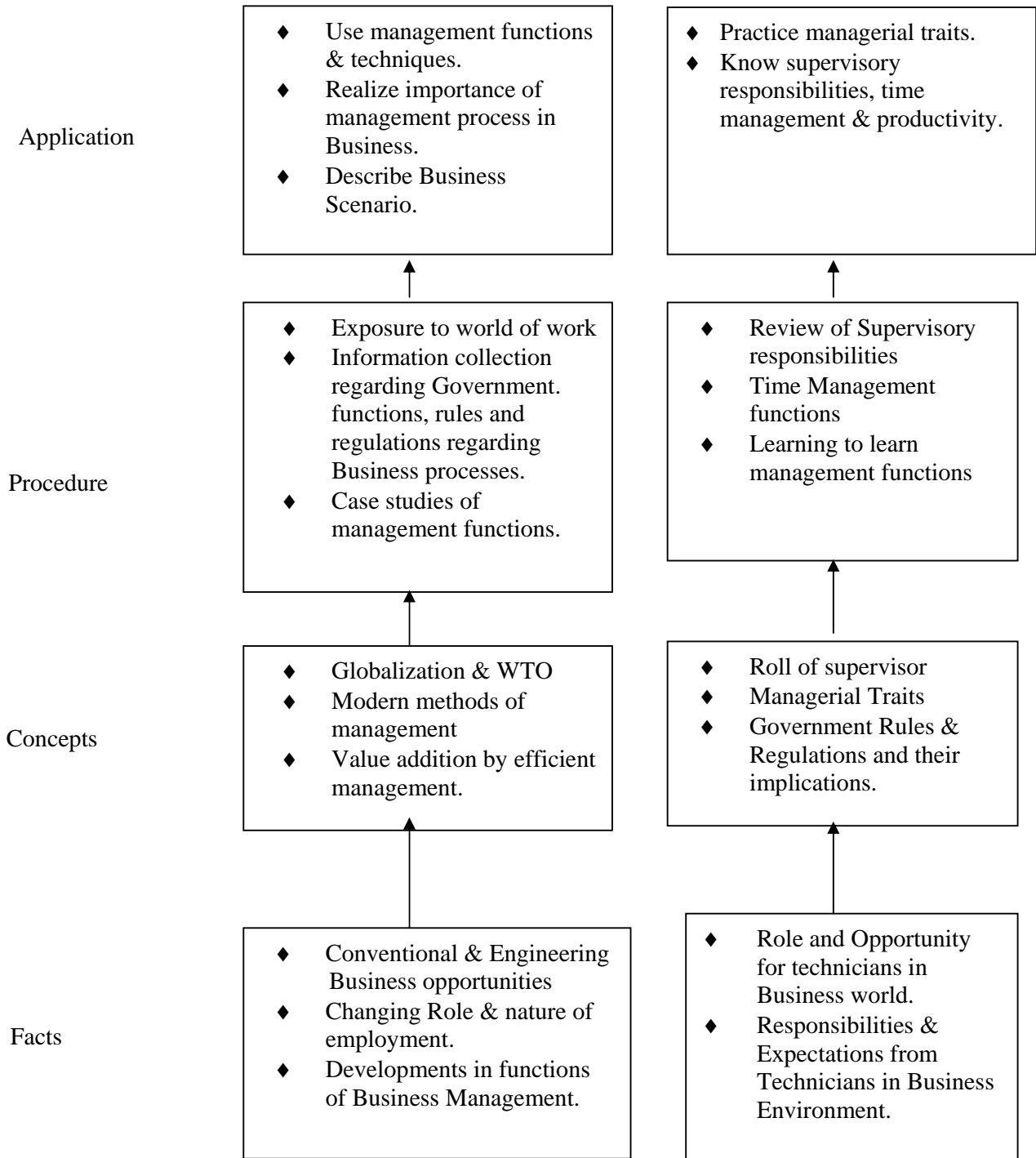
After completion of three years of technical training, Polytechnic students are expected to enter in to the World of Work. The business environment is altogether different and new to the students. A proper introduction and understanding of Business Processes is therefore essential for all Polytechnic students. Management is a subject which deals with basics of Managerial science required to understand the processes in Industrial & Commercial environment. This will enable the students of Polytechnics to become familiar and to understand various Business Organizational structures, their functioning and the Role these technicians will have to play in these setups with responsibilities.

**Objective:**

The students will able to:

1. Familiarize environment in the world of work
2. Explain the importance of management process in Business.
3. Identify various components of management.
4. Describe Role & Responsibilities of a Technician in an Organizational Structure.
5. Apply various rules and regulations concerned with Business & Social responsibilities of the Technician.

**Learning Structure:**



**Contents: Theory**

<b>Chapter</b>	<b>Name of the Topics</b>	<b>Hours</b>	<b>Marks</b>
01	<b>Overview of Business</b> 1.1. Types of Business <ul style="list-style-type: none"> <li>• Service</li> <li>• Manufacturing</li> <li>• Trade</li> </ul> 1.2. Industrial sectors <ul style="list-style-type: none"> <li>• Introduction to</li> <li>• Engineering Industry</li> <li>• Process Industry</li> <li>• Textile Industry</li> <li>• Chemical Industry</li> <li>• Agro Industry</li> </ul> 1.3 Globalization <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Advantages &amp; disadvantages w.r.t India</li> </ul> 1.4 Intellectual Property Rights I( I P R ) <ul style="list-style-type: none"> <li>• Concept</li> <li>• Types of IPR</li> </ul>	02	04
02	<b>Management Process</b> 2.1 What is Management? <ul style="list-style-type: none"> <li>• Evolution</li> <li>• Various Definitions</li> <li>• concept of Management</li> <li>• Levels of Management</li> <li>• Administration and Management</li> <li>• Scientific Management by F W Taylor</li> </ul> 2.2 Principles of Management (14 principles of Henry Fayol) 2.3 Functions of Management: <ul style="list-style-type: none"> <li>• Planning</li> <li>• Organizing</li> <li>• Coordinating</li> <li>• Directing</li> <li>• Controlling</li> <li>• Decision Making</li> </ul>	07	14
03	<b>Organizational Management</b> 3.1 Organization <ul style="list-style-type: none"> <li>• Definition</li> <li>• Steps in forming organization</li> </ul> 3.2 Types of Organization <ul style="list-style-type: none"> <li>• Line</li> <li>• Line &amp; Staff</li> <li>• Functional</li> <li>• Project type</li> </ul> 3.3 Departmentation <ul style="list-style-type: none"> <li>• Centralized &amp; Decentralized</li> </ul>	07	14

	<ul style="list-style-type: none"> <li>• Authority &amp; Responsibility</li> <li>• Span of Control (Management)</li> </ul> <p>3.4 Forms of ownerships</p> <ul style="list-style-type: none"> <li>• Proprietorship</li> <li>• Partnership</li> <li>• Joint stock company</li> <li>• Co-operative society</li> <li>• Govt. Sector</li> </ul>		
04	<p><b>Human Resource Management</b></p> <p>4.1 Personnel Management</p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Definition</li> <li>• Function</li> </ul> <p>4.2 Staffing</p> <ul style="list-style-type: none"> <li>• Introduction to HR</li> <li>• Introduction to HR Planning</li> <li>• Recruitment procedure</li> </ul> <p>4.3 Personnel – Training &amp; Development</p> <ul style="list-style-type: none"> <li>• Types of training <ul style="list-style-type: none"> <li>- Induction</li> <li>- Skill enhancement</li> </ul> </li> </ul> <p>4.4 Leadership &amp; Motivation</p> <ul style="list-style-type: none"> <li>• Leadership- Styles &amp; types</li> <li>• Motivation –Definition , Intrinsic &amp; Extrinsic</li> <li>• Maslow's theory of Motivation and its significance</li> </ul> <p>4.5 Safety Management</p> <ul style="list-style-type: none"> <li>• Causes of Accidents</li> <li>• Safety Procedures</li> </ul> <p>4.6 Introduction, Objectives &amp; feature of Industrial Legislation such as</p> <ul style="list-style-type: none"> <li>• Factory Act</li> <li>• ESI Act,</li> <li>• Workman Compensation Act,</li> <li>• Industrial Dispute Act.</li> </ul>	08	20
05	<p><b>Financial Management (No Numericals)</b></p> <p>5.1. Financial Management- Objectives &amp; Functions</p> <p>5.2. Capital Generation &amp; Management</p> <ul style="list-style-type: none"> <li>• Types of capitals</li> <li>• Sources of finance</li> </ul> <p>5.3. Budgets and Accounts</p> <ul style="list-style-type: none"> <li>• Types of Budgets</li> <li>• Production Budget ( including Variance Report)</li> <li>• Labour Budget</li> <li>• Introduction to Profit &amp; Loss Account ( Only concept)</li> <li>• Balance sheet etc.</li> </ul> <p>5.4. Introduction to Various Taxes</p> <ul style="list-style-type: none"> <li>• Excise Service Tax,</li> <li>• Income Tax</li> </ul>	08	18

	<ul style="list-style-type: none"> <li>• VAT</li> <li>• Custom Duty.</li> </ul>		
06	<b>Materials Management</b> 6.1. Inventory Management ( No Numericals) <ul style="list-style-type: none"> <li>• Meaning &amp; Objectives</li> </ul> 6.2 ABC Analysis 6.3 Economic Order Quantity: <ul style="list-style-type: none"> <li>• Introduction &amp; Graphical Representation</li> </ul> 6.4 Purchase Procedure <ul style="list-style-type: none"> <li>• Objectives of Purchasing</li> <li>• Functions of Purchasing Department</li> <li>• Steps in Purchasing</li> </ul> 6.5 Modern Techniques of Material Management <ul style="list-style-type: none"> <li>• Introductory treatment to Just in Time( JIT)/ System Applications &amp; Products (SAP) /Enterprise Resource Planning (ERP)</li> </ul>	08	18
07	<b>Project Management (Simple /Elementary Numericals)</b> 7.1 Project Management <ul style="list-style-type: none"> <li>• Introduction &amp; Meaning</li> <li>• Introduction to CPM/PERT Techniques ( simple network problems )</li> <li>• Concept of Break Even Analysis and its significance</li> </ul> 7.2 Quality Management <ul style="list-style-type: none"> <li>• Definition of Quality, Concept of Quality, Quality Circle, Quality Assurance</li> <li>• Introduction to TQM, Kaizen, 5 'S' &amp; Six Sigma</li> </ul>	08	12
<b>Total</b>		<b>48</b>	<b>100</b>

**Learning Resources:****Books:**

Sr. No	Author	Title	Publisher
01	Dr. O.P. Khanna	Industrial Engg & Management	Dhanpal Rai & sons New Delhi
02	Dr. S.C. Saksena	Business Administration & Management	Sahitya Bhavan Agra
03	W.H. Newman E.Kirby Warren Andrew R. McGill	The process of Management	Prentice- Hall of India Pvt. Ltd. New Delhi - 110001

**Video Cassetts:**

Sr. No	Subject	Source
1	Business opportunity selection and guidance	Website : <a href="http://www.ediindia.org">http://www.ediindia.org</a>
2	Planning for completion and Growth	

**Course Name : Diploma in Mechanical Engineering**

**Course Code : ME/MH/MI**

**Semester : Sixth for Me and Seventh for MH/MI**

**Subject Title : Design of Machine Elements**

**Subject Code : 12241**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	04	100	--	25#	25@	150

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

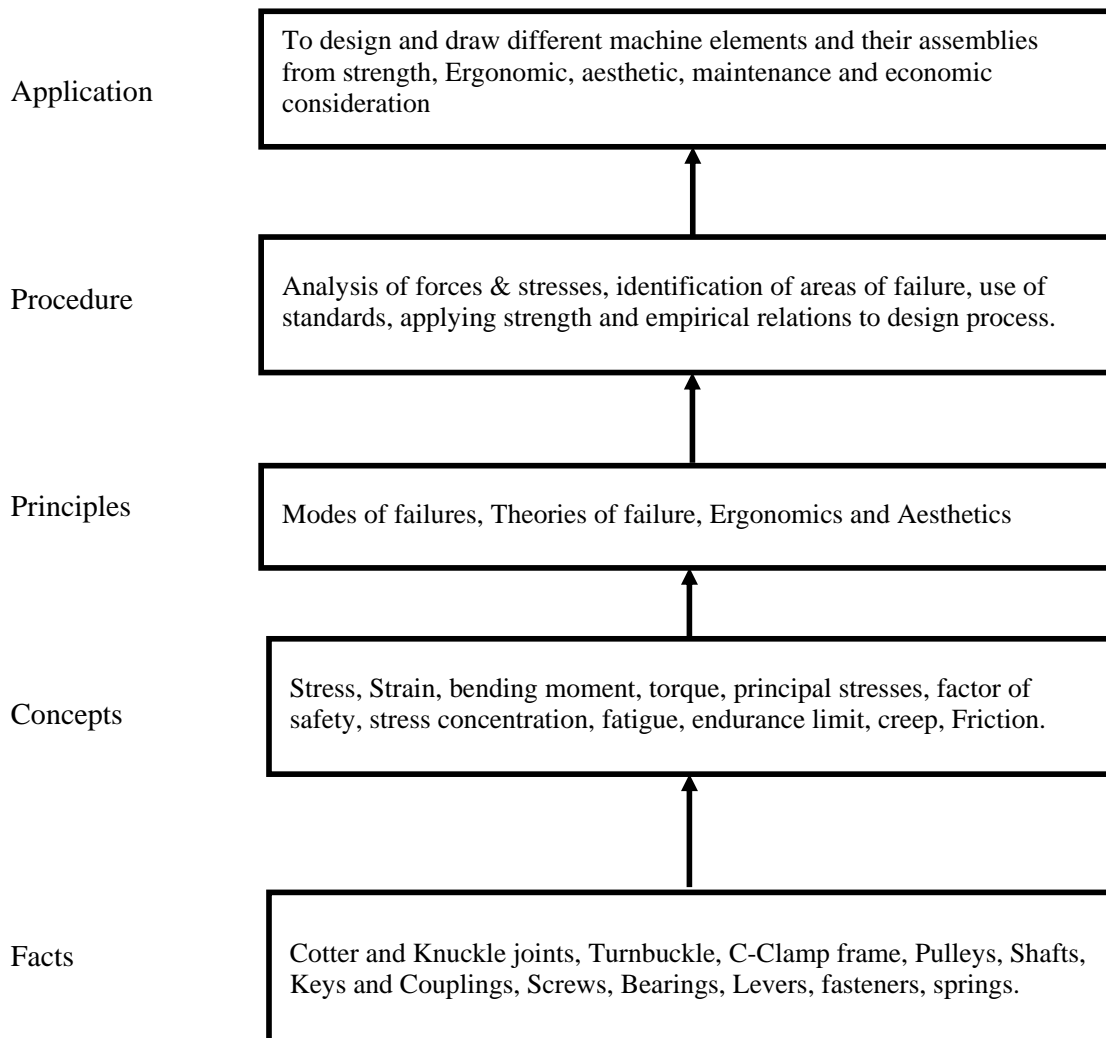
**Rationale:**

It is an Applied Technology subject. A diploma holder is expected to design and draw simple machine components used in small and medium scale industries. Fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machines is essential. Subject aims at developing analytical abilities to give solutions to engineering design problems.

**Objectives:**

Students should be able to:

1. Analyze the various modes of failure of machine components under different load patterns.
2. Design and prepare part and assembly drawings.
3. Use design data books and different codes of design.
4. Select standard components with their specifications from manufacturer's catalogue.
5. Develop drawings on CAD software.

**Learning Structure:**



**Contents: Theory**

<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
01	<p><b>Introduction to Design</b></p> <p><b>1.1</b> a) Machine Design philosophy and Procedures b) General Considerations in Machine Design</p> <p><b>1.2</b> a) Fundamentals:- Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure Intensity, Crushing, bending and torsion, Principle Stresses (Simple Numerical) b) Creep strain and Creep Curve</p> <p><b>1.3</b> a) Fatigue, S-N curve, Endurance Limit. b) Factor of Safety and Factors governing selection of factor of Safety.</p> <p><b>1.4</b> Stress Concentration – Causes &amp; Remedies</p> <p><b>1.5</b> a) Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety &amp; service factor. b) Properties of Engineering materials, Designation of materials as per IS and introduction to International standards &amp; advantages of standardization, use of design data book, use of standards in design and preferred numbers series.</p> <p><b>1.6</b> Theories of Elastic Failures – Principal normal stress theory, Maximum shear stress theory &amp; maximum distortion energy theory.</p>	10	16
02	<p><b>Design of simple machine parts</b></p> <p><b>2.1</b> Cotter Joint, Knuckle Joint, Turnbuckle</p> <p><b>2.2</b> Design of Levers:- Hand/Foot Lever &amp; Bell Crank Lever</p> <p><b>2.3</b> Design of C – Clamp, Off-set links, Overhang Crank, Arm of Pulley</p>	08	16
03	<p><b>Design of Shafts, Keys and Couplings and Spur Gears</b></p> <p><b>3.1</b> Types of Shafts, Shaft materials, Standard Sizes, Design of Shafts (Hollow and Solid) using strength and rigidity criteria, ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley</p> <p><b>3.2</b> Design of Sunk Keys, Effect of Keyways on strength of shaft.</p> <p><b>3.3</b> Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling.</p> <p><b>3.4</b> Spur gear design considerations. Lewis equation for static beam strength of spur gear teeth. Power transmission capacity of spur gears in bending.</p>	12	20

04	<b>Design of Power Screws</b> <b>4.1</b> Thread Profiles used for power Screws, relative merits and demerits of each, self locking and overhauling property <b>4.2</b> Torque required to overcome thread friction, efficiency of power screws, types of stresses induced. <b>4.3</b> Design of Screw Jack, Toggle Jack.	10	12
05	<b>Design of springs</b> <b>5.1</b> a) Classification and Applications of Springs, Spring – terminology, materials and specifications. b) Stresses in springs, Wahl's correction factor, Deflection of springs, Energy stored in springs. <b>5.2</b> Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers and governor springs. <b>5.3</b> Leaf springs – construction and application	08	12
06	<b>Design of Fasteners</b> <b>6.1</b> Stresses in Screwed fasteners, bolts of Uniform Strength. <b>6.2</b> Design of Bolted Joints subjected to eccentric loading. <b>6.3</b> Design of parallel and transverse fillet welds, axially loaded symmetrical section, Merits and demerits of screwed and welded joints	08	12
07	<b>Antifriction Bearings</b> <b>7.1</b> a) Classification of Bearings – Sliding contact & rolling contact. b) Terminology of Ball bearings – life load relationship, basic static load rating and basic dynamic load rating, limiting speed. Selection of ball bearings using manufacturer's catalogue.	05	08
08	<b>Ergonomics &amp; Aesthetic consideration in design</b> <b>8.1</b> a) Ergonomics of Design – Man –Machine relationship. Design of Equipment for control, environment & safety. b) Aesthetic considerations regarding shape, size, color & surface finish.	03	04
<b>Total</b>		<b>64</b>	<b>100</b>

**Assignments:**

Skills to be developed:

**Intellectual Skills:**

1. Understand the basic philosophy and fundamentals of Machine Design.
2. Apply and use the basic knowledge of earlier subjects like mechanical Engineering, materials, strength of materials and theory of machines.
3. Analyse and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
4. Understand the modes of failures of m/c components and decide the design criteria and equations.
5. Understand the concept of standardization and selecting standard components.
6. Understand the methods of computer aided design practices.

**Motor Skills:**

1. Draw the components assembly as per the designed dimensions.
2. Modify drawings and design as per requirement.
3. Use the different design software.
4. Use different design data books and IS codes.

**List of Assignments:**

1. Assignment on selection of materials for given applications [at least five applications should be covered] using design data book. List the mechanical properties of material selected. **2 Hrs**
2. Problems on design of simple machine parts like Cotter Joint, Knuckle Joint, Bell Crank Lever, Turn Buckle, Off – Set link, Arm of Pulley (One example on each component) with free hand sketches. **6 Hrs**
3. Design Project No. 1  
Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motor or engine etc.). By selecting suitable materials, design the shaft, key and coupling. Also select suitable Ball Bearing from Manufacture's catalogue. Prepare design report and assembly drawing indicating overall dimensions, tolerances, and surface finish. Also prepare bill of materials. (Activity should be completed in a group of five to six students) **6 Hrs**
4. Design Project No. 2  
Observe the System where transmission of power takes place through power Screws.  
( e.g. Lead screw of lathe, feed screws of machine tools, Clamping screws, Toggle Jack screw, etc.)  
Get the required information regarding effort, clamping force, etc., and selecting suitable materials design screw, nut and different simple components in assembly. Prepare design report and assembly drawing indicating overall dimensions, tolerances and surface finish. Also prepare bill of materials. (Activity should be completed in a group of five to six students) **4 Hrs**
5. Assignments on design of Helical Springs, Screwed joints, Welded joints [one each] with free hand sketches. **2 Hrs**
6. CAD Drawing for project No 1 or 2 should be prepared in practical and print out should be attached along with respective drawing sheets **8 Hrs**
7. Survey of Prime movers – Electric motors / I.C. Engines available in the market along with specifications suitable for your design project. Survey report should be prepared with the relevant catalogue. **4 Hrs**

**Learning Resources:****1. Books:**

SN	Author	Title	Publication
01	V.B.Bhandari	Introduction to Machine Design	Tata Mc- Graw Hill
02	R.K.Jain	Machine Design	Khanna Publication
03	Pandya & Shah	Machine design	Dhanpat Rai & Son
04	Joseph Edward Shigley	Mechanical Engg. Design	Mc- Graw Hill
05	PSG Coimbtore	Design Data Book	PSG Coimbtore
06	Abdulla Shariff	Hand Book of Properties of Engineering Materials & Design Data for Machine Elements	Dhanpat Rai & Sons
07	Hall, Holowenko, Laughlin	Theory and Problems of Machine Design	Mc- Graw Hill

**2. IS/ International Codes**

- a) IS 4218: 1967                      ISO Metric Threads
- b) IS 2693: 1964                      Cast Iron Flexible Couplings
- c) IS 2292: 1963                      Taper keys & Keyways
- d) IS 2293: 1963                      Gib Head Keys & Keyways
- e) IS 2389: 1963                      Bolts, Screws, Nuts & Lock Nuts
- f) IS 4694: 1968                      Square threads
- g) IS 808: 1967                        Structural Steel
- h) SKF Catalogue for Bearings

**Course Name : Diploma in Mechanical Engineering**

**Course Code : ME/MH/MI/PG/PT**

**Semester : Sixth for ME/PG/PT and Seventh for MH/MI**

**Subject Title : Industrial Fluid Power**

**Subject Code : 12242**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	25#	25@	150

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)

**Rationale:**

Oil Hydraulic systems & pneumatic systems are widely used in all fields of engineering as clean source of motive power. Low cost automation systems with the use of pneumatics have become popular as manufacturing aids.

Diploma engineers come across such systems in all segments of industries.

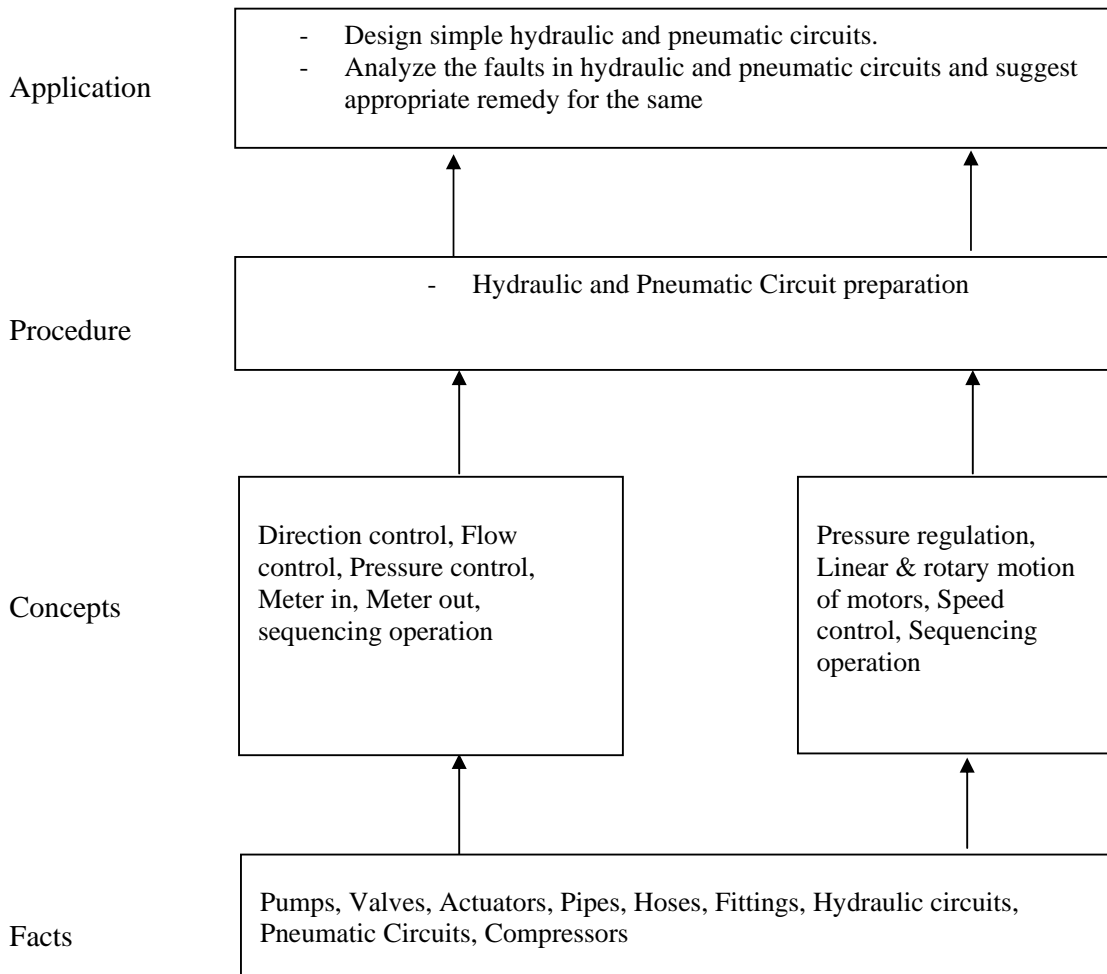
Hence the subject will give the students basic skills and knowledge, which will be directly needed in the industrial environment.

**Objectives:**

The student will be able to.

- 1) Identify various components of hydraulic & pneumatic systems.
- 2) Know the working principle of various components used for hydraulic & pneumatic systems.
- 3) Select appropriate components required for simple hydraulic and pneumatic circuits.
- 4) List probable causes of faults or defects in the components of hydraulic & pneumatic circuits.

**Learning Structure:**



**Contents: Theory**

Chapter	Name of the topic	Hours	Marks
01	<b>Introduction to oil hydraulic systems</b> 1.1 Practical applications of hydraulic systems. 1.2 General layout of oil hydraulic systems. 1.3 Merits and limitations of oil hydraulic systems. 1.4 Properties of hydraulic fluid –viscosity, demulsibility, lubricity etc.	03	04
02	<b>Components of Hydraulic systems</b> 2.1 Pumps – Vane pump, gear pump, Gerotor pump, screw pump, piston pump 2.2 Valves – Construction, working and symbols of Pressure control valves – pressure relief valve, pressure reducing, pressure unloading Direction control valves – Poppet valve, spool valve, 3/2, 4/2 D.C. valves, Sequence valves. Flow control valves – pressure compensated, non pressure compensated flow control valve. 2.3 Actuators- Construction, working and symbols of Rotary Actuators - Hydraulic motors Linear Actuators – Cylinders - single acting, double acting. 2.4 Accessories – Pipes, Hoses, fittings, Oil filters, Seals and gaskets, Accumulators. (Types, construction, working principle and symbols of all components)	22	08 08 08 08
03	<b>Hydraulic Circuits</b> 3.1 Meter in, Meter out circuits 3.2 Bleed off circuit 3.3 Sequencing circuit – travel dependant, pressure dependant 3.4 Hydraulic circuits for Milling machine, Shaper machine, Motion synchronization circuit.	07	16
04	<b>Introduction to pneumatic Systems</b> 4.1 Applications of pneumatic system 4.2 General layout of pneumatic system 4.3 Merits and limitations of pneumatic systems	04	04
05	<b>Components of pneumatic system</b> 5.1 Compressor – Reciprocating & Rotary compressors. 5.2 Control Valves – Pressure regulating valves, Flow Control valves, Direction Control Valves. 5.3 Actuators – Rotary - Air motors, Types, construction, working principle Linear- Cylinders- Types, construction & working principle 5.4 Accessories – Pipes, Hoses, Fittings, FRL unit (Types, construction, working principle and symbols of all components)	22	04 12 08 08
06	<b>Pneumatic Circuits</b> Speed control circuits -- for double acting cylinder -- for bidirectional air motor Sequencing circuits -- Position based sequencing circuit -- Time delay circuit	06	12
<b>Total</b>		<b>64</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. Prepare simple hydraulic & pneumatic circuits.
2. Compare the performance of hydraulic & pneumatic systems.
3. Identify the faults & suggest remedies in hydraulic & pneumatic circuits.
4. Select proper circuit considering its application

**Motor Skills:**

1. Connect different components as per given drawing
2. Perform repairing and replacement of defective components in the circuit
3. Draw the hydraulic and pneumatic circuits using symbols

**List of Practical:**

- 1) Demonstration of meter in and meter out circuit.
- 2) Demonstration of sequencing circuit.
- 3) Demonstration of hydraulic circuit for shaper machine.
- 4) Demonstration of pneumatic circuit for speed control of double acting cylinders.
- 5) Demonstration of pneumatic circuit for speed control of pneumatic motor.
- 6) Study of trouble shooting procedures of various hydraulic and pneumatic circuits.
- 7) Selection of circuit components for simple hydraulic and pneumatic circuits.

**Mini Projects:**

- 1) Survey of oil used for hydraulic circuits -specifications, manufacturer's names, costs etc.
- 2) Study of any one mobile hydraulic system like in earth moving equipments and its detailed report.

OR

Study of any one stationary hydraulic system, like in any machine tool and its detailed report.

**Learning Resources:****1. Books:**

Sr. No.	Author	Title	Publisher
01	Pippenger Hicks	Industrial Hydraulics	McGraw Hill International
02	Majumdar S.R	Oil Hydraulic system- Principle and maintenance	Tata McGraw Hill



03	Majumdar S.R	Pneumatics Systems Principles and Maintenance	Tata McGraw Hill
04	Stewart	Hydraulics and Pneumatics	Taraporewala Publication

**2. Catalogues:**

Various system components' manufacturers' Catalogues.

**3. CDs:**

CDs developed by various system components' manufacturers.

**Course Name: Mechanical Engineering Group**

**Course Code : ME/MH/MI/PG/PT/FE**

**Semester : Sixth for ME/PG/PT and Seventh for MH/MI/FE**

**Subject Title : Production Technology**

**Subject Code : 12243**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW@	TOTAL
04	--	--	03	100	--	--	--	100

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

**Rationale:**

This subject is technology subject. A Technician is required to work at the highest productivity level. His productivity is dependent on the productivity of the machines and the people in the manufacturing system. Hence he should learn the techniques for improvement in productivity of the people and equipment.

A technician required to plan the production schedule accordingly organize material supply for the manufacturing activities. The total cost of goods produced contains large portion of overhead cost. Technician is required to minimize the direct and indirect cost by optimizing the use of resources available to him. Hence he should learn accounting process, inventory control and process planning.

Modern manufacturing system employ techniques such as JIT, TPM, FMS, 5'S', kaizen which should be known to the technician.

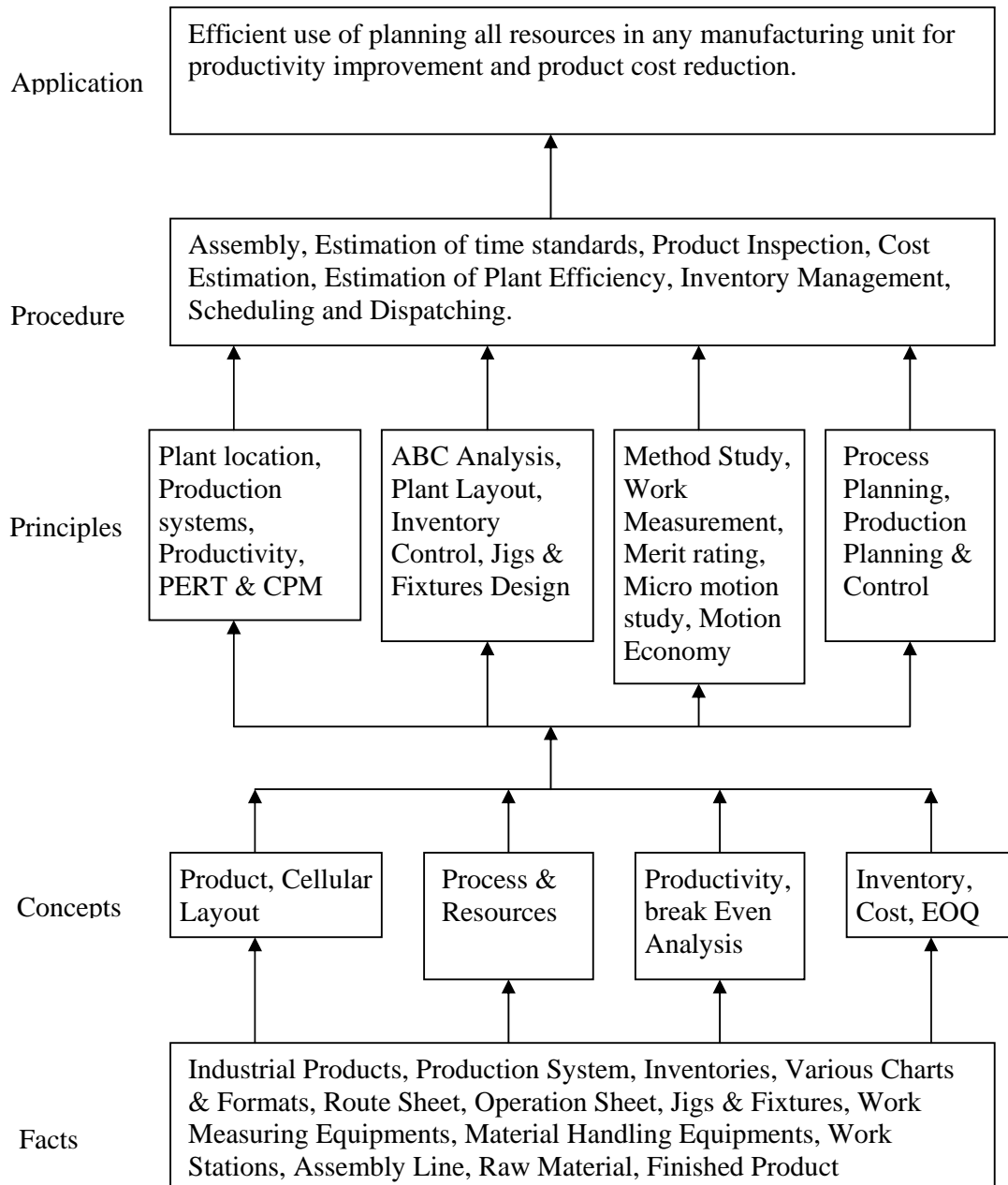
**Objectives:**

Students will be able to;

1. Understand importance of productivity and factors for improvement of productivity.
2. Know different production systems and modern trends in manufacturing systems.
3. Find the break even point for manufacturing a product.
4. Prepare / modify layout of production system.
5. Select suitable material handling devices and plant facilities.
6. Prepare process plan and specify tooling for it.
7. Prepare process chart for analysis of existing process.
8. Use PERT & CPM techniques for scheduling and controlling the manufacturing activities.

9. Apply techniq
10. ues of method study and work measurement for improvement of existing manufacturing methods.
11. Find the economic order quantity (EOQ) for given situation.

**Learning Structure:**



**Contents: Theory**

<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
01	<b>PRODUCTION SYSTEM</b> 1.1 Production - Definition , Types of production systems 1.2 Productivity - Importance , Measurement of Productivity, Techniques of improving productivity. 1.3 Elements of cost- Fixed cost, Variable Cost. Break even analysis, Calculation of Break even point.	05	10
02	<b>PLANT LOCATION, PLANT LAYOUT AND MATERIAL HANDLING</b> 2.1 Plant Location - Importance of Site Selection, Factors affecting Site Selection, Government Policies, relaxation for Backward Areas. 2.2 Plant Layout - Objectives, types, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout. 2.3 Group Technology, Cellular layout. 2.4 Material handling – Need, Principles and Types of material handling devices – conveyors , Hoist & cranes , forklift truck, trolleys, Pipes, Automated Guided Vehicles (AGV's) Selection of Material Handling systems and Devices.	08	16
03	<b>PROCESS PLANNING</b> 3.1 Planning of Processes from raw material to finished product, Factors affecting Process Planning, 3.2 Deciding sequence of operations, Operation Sheet, Combined operations, Determination of Inspection Stages. Selection of Machine 3.3 Techniques of assembly planning, Types of assembly. 3.4 Plant Capacity, Machine Capacity, Plant Efficiency. Numerical not to be asked,	08	12
04	<b>PRODUCTION PLANNING AND CONTROL</b> 4.1 Definition & concept of Routing, Sequencing [n job 2 machines] Scheduling, Dispatching. 4.2 Meaning of Control, Progressive Control. 4.3 Gantt chart. 4.4 Concept of Line balancing,	06	10
05	<b>WORK STUDY</b> 5.1 Method Study- Definition, Objectives, Procedure, Selection of work. 5.2 Recording Techniques:- Process Charts – Outline process chart, Flow process chart, Two Hand process chart, Multiple activity chart, Flow diagram, String diagram, Travel chart. 5.3 Micro motion study-Critical Examination, Principles of Motion Economy, Concept of ergonomics and workplace layout. <b>Work Measurement -</b> 5.4 Objectives, procedure, Time Study, Time Study Equipments. Stop Watch Time Study, Standard Time, Work Sampling, 5.5 Analytical Estimating, Predetermined Motion Time Study, Allowances, Calculation of Standard Time, 5.6 Concept of Merit Rating.	12	16
06	<b>INVENTORY CONTROL</b>	10	14

	6.1 Methods of Inventory Management 6.2 Inventory Cost relationship, Deciding Economic Batch Quantity, EOQ Model, Calculation of EOQ, Concepts of discounts. 6.3 Introduction of Material Requirement Planning. 6.4 Stores Function – Storage systems – One bin , Two bin system, Material Issue Request (MIR), Bin card.		
07	<b>JIGS AND FIXTURES</b> 7.1 Introduction. Difference between jig and fixture, Different components of Jig/ fixture, Types of jigs and fixtures. 7.2 Types of locators and clamping devices, 3-2-1 principle of location. 7.3 General principles of jig/fixture, design.	04	08
08	<b>MODERN TRENDS</b> 8.1 Just In Time manufacturing – Pull and push types of manufacturing systems. 8.2 5 'S'- concepts, meaning of each term, 5 'S' as Waste management technique, inventory reduction by 5 'S'. 8.3 Single Piece Production Systems. 8.4 Basic concepts of <ul style="list-style-type: none"> <li>• Kaizen, Brain storming.</li> <li>• Poka Yoke.</li> <li>• Lean manufacturing</li> <li>• Business Process Re-engineering</li> <li>• DMIAC cycle</li> <li>• Flexible Manufacturing System.</li> <li>• Rapid Prototyping – concept, need, method, advantages, limitations.</li> </ul>	12	16
<b>Total</b>		<b>64</b>	<b>100</b>

**Learning Resources:****Books:**

Sr. No.	Author	Name of Book	Publication
01	L.C. Jhamb	Industrial Management	Everest
02	James C. Rigs	Production System, Planning, Analysis & Control	N.Y.Wiley & Sons
03	O.P. Khanna	Industrial Engineering and Management	Dhanpat Rai & Sons
04	ILO	Work Study	ILO Geneva
05	P. H. Joshi	Jigs & Fixtures	--
06	P.C. Sharma	Production Engineering	--
07	Kempster	Introduction to Jigs and Fixtures Design	--
08	Baffna , Sarin	Modern Production and Operations Management	--
09	Terry Wireman	Total Productive Maintenance	Industrial press inc.
10	Taiichi ohno	Toyota Production system	Productivity Press

**Course Name : Mechanical Engineering Group**

**Course Code : ME/MH/MI/AE/PG/PT**

**Semester : Sixth for ME/AE/PG/PT and Seventh for MH/MI**

**Subject Title : Industrial Project**

**Subject Code : 12248**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	06	--	--	--	50#	50@	100

**Rationale:**

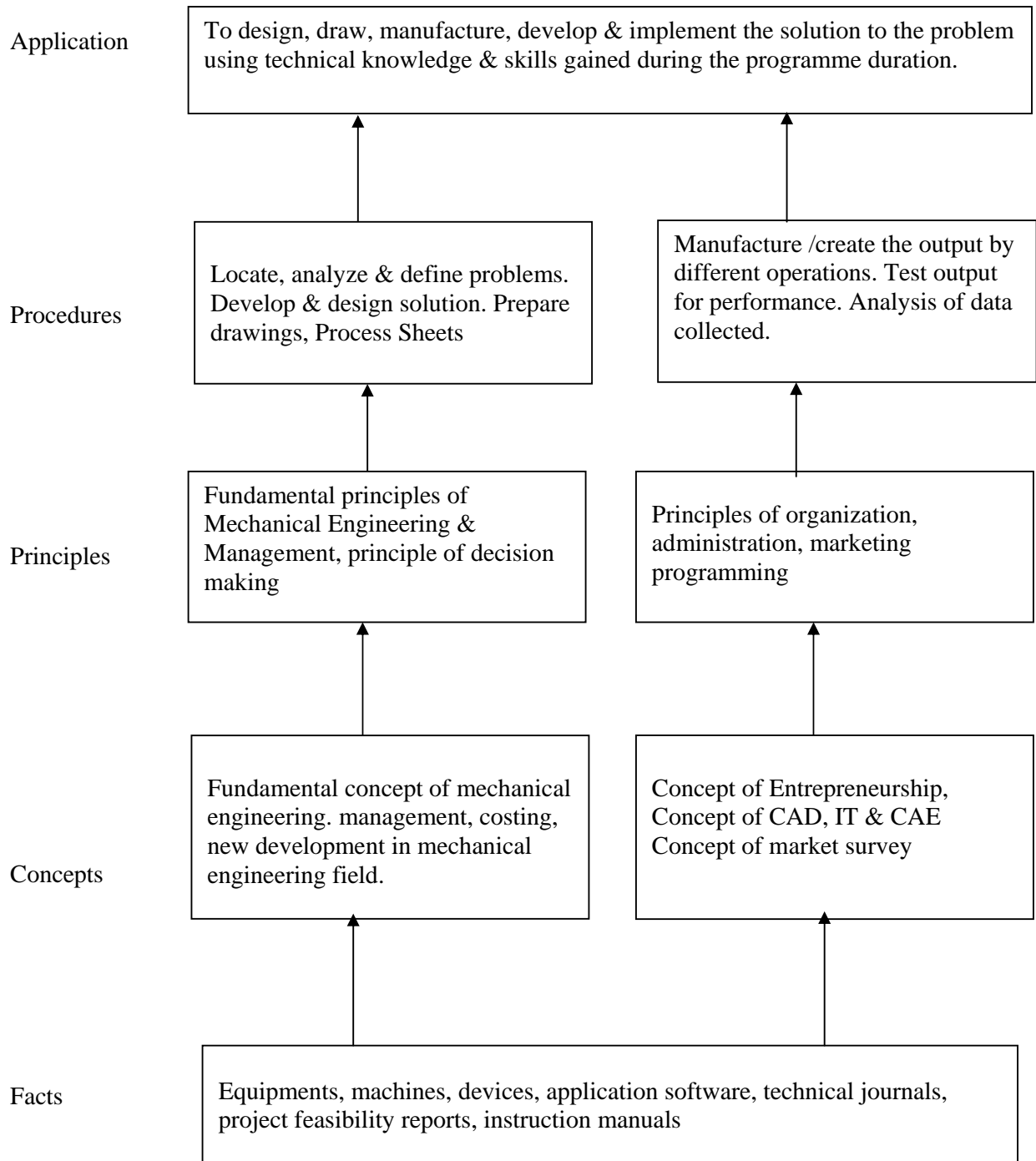
In practice the diploma technicians come across problems of varied nature. He/she will have to solve the problems involving drawings, designs, manufacturing, installation, testing and maintenance of machines. In order to cultivate the systematic methodology for problem solving using acquired technical knowledge & skills, this particular subject is introduced. This subject will also help to enhance the generic skills & professional skills.

**Objectives:**

The student will be able to-

1. Identify, analyse & define the problem.
2. Generate alternative solutions to the problem identified.
3. Compare & select feasible solutions from alternatives generated.
4. Design, develop, manufacture & operate equipment/program.
5. Acquire higher-level technical knowledge by studying recent development in mechanical engineering field.
6. Compare machines/devices/apparatus for performance practices.
7. Work effectively in team.

**Learning Structure:**



**Contents:****Skills To Be Developed:****Intellectual Skills**

1. Design the related machine components & mechanism.
2. Convert innovative or creative idea into reality.
3. Understand & interpret drawings & mechanisms
4. Select the viable, feasible & optimum alternative from different alternatives.

**Motors skills**

1. Use of skills learnt in workshop practical.
2. Assemble parts or components to form machine or mechanisms.
3. Classify & analyze the information collected.
4. Implement the solution of problem effectively.

- Notes:** 1) Project group size: Maximum 4 students  
2) Project report will be of minimum 40 pages unless otherwise specified.  
3) Project diary should be maintained by each student.

**Part A-Project**

A batch of maximum 4 students will select a problem and then plan, organize & execute the project work of solving the problem in a specified duration. Student is expected to apply the knowledge & skills acquired. Batch may select any one problem/project work from following categories.

- a) Fabrication of small machine / devices/ test rigs/ material handling devices/ jig & fixtures/ demonstration models, etc. Report involving aspects of drawing, process sheets, costing, Installation, commissioning & testing should be prepared and submitted.
- b) Design & fabrication of mechanisms, machines, Devices, etc. Report involving aspects of designing & fabricating should be prepared & submitted .
- c) Development of computer program for designing and /or drawing of machine components, Simulation of movement & operation, 3D modeling, pick & place robots etc.
- d) Industry sponsored projects- project related with solving the problems identified by industry should be selected. One person / engineer from industry is expected to work as co- guide along with guide from institution.
- e) Literature survey based projects: Project related with collection tabulation, classification, analysis & presentation of the information. Topic selected must be related with latest



technological developments in mechanical or mechatronics field, and should not be a part of diploma curriculum. Report should be of min 60 pages.

- f) Investigative projects- Project related with investigations of causes for change in performance or structure of machine or component under different constraints through experimentation and data analysis.
- g) Maintenance based projects: The institute may have some machine/ equipment/ system which are lying idle due to lack of maintenance. Students may select the specific machines/equipment/system. Overhaul it, repair it and bring it to working condition. The systematic procedure for maintenance to be followed and the report of the activity be submitted.
- h) Industrial engineering based project: Project based on work study , method study, methods improvement, leading to productivity improvement, data collection, data analysis and data interpretation be undertaken .
- i) Low cost automation projects: Project based on hydraulic/pneumatic circuits resulting into low cost automated equipment useful in the identified areas.
- j) Innovative/ Creative projects – Projects related with design, develop & implementation of new concept for some identified useful activity using PLC, robotics, non-conventional energy sources, CIM , mechatronics, etc.
- k) Environmental management systems projects: Projects related with pollution control, Solid waste management, liquid waste management, Industrial hygiene, etc, Working model or case study should be undertaken.
- l) Market research/ survey based projects: Projected related with identification of extent of demand, sales forecasting, Comparative study of marketing strategies, Comparative study of channels of distribution, Impact of variables on sales volume, etc. The project involves extensive survey & market research activities information to be collected through various mechanisms/tools & report be prepared.
- m) Project based on use of appropriate technology particularly benefiting rural society or economically weaker section.
- n) Project can be selected other than the area specified above. Project should provide viable and feasible solution to the problem identified. Report should be of min 50 pages.

### **Part B- Seminar**

Every student will prepare & deliver the seminar. Evaluation of seminar will be carried out by panel of at least three teaching staff from mechanical/ production /automobile department.

1. Selection of topic for the seminar should be finalized in consultation with teacher guide allotted for the batch to which student belongs.
2. Seminar report should be of min.10 & max. 20 pages & it should be certified by guide teacher and head of the department

3. for presentation of seminar, following guide lines are expected to be followed:-

- a) Time for presentation of seminar: 7 to 10 minutes /student.
- b) Time for question/answer : 2 to 3 minutes /student
- c) Evaluation of seminar should be as follows:-

Presentation: 15 marks

Use of A. V. aids: 05 marks

Question /answer: 05 marks

Total: 25 marks

d) use of audio visual aids or power point presentation is desirable.

4. Topic of the seminar should not be from diploma curriculum

5. Seminar can be on project selected by batch.

### Learning Resources:

#### 1. Books:

Sr. No	Author	Title	Publication
1	Karl Smith	Project management & Team work	Tata- Mc Graw Hill
2	Clifford gray & Erik Lasson	Project management	Tata- Mc Graw Hill

#### 2. Magazines:

1. Invention intelligence magazine
2. Popular mechanics Journals/ Magazines

**Course Name : Diploma in Mechanical Engineering**

**Course Code : ME/PG/PT/MH/FE/MI**

**Semester : Sixth for ME/PG/PT & Seventh for MH/MI/FE**

**Subject Title : Professional Practices-VI**

**Subject Code : 12249**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	05	--	--	--	--	50@	50

**Rationale:**

Most of the diploma holders join industries. Due to globalization and competition in the industrial and service sectors the selection for the job is based on campus interviews or competitive tests.

While selecting candidates a normal practice adopted is to see general confidence, ability to communicate and attitude, in addition to basic technological concepts.

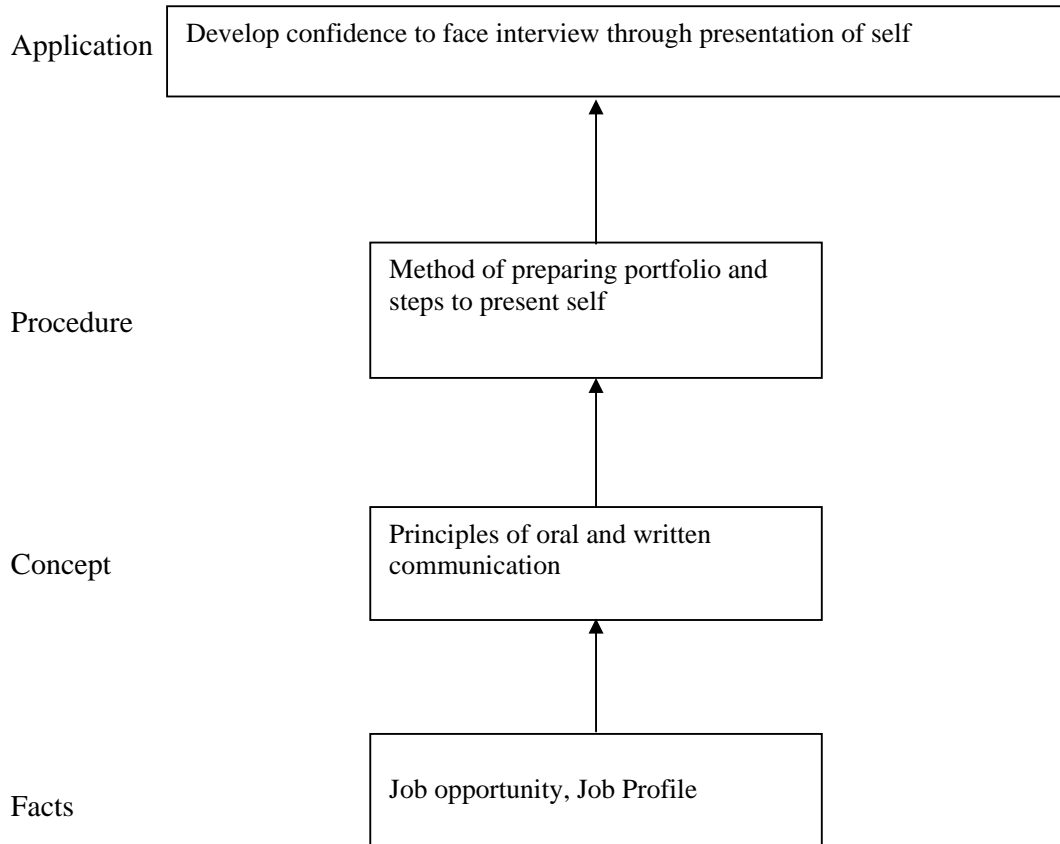
The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process.

**Objectives:**

Student will be able to:

1. Acquire information from different sources.
2. Prepare notes for given topic.
3. Present given topic in a seminar.
4. Interact with peers to share thoughts.
5. Prepare a report on industrial visit, expert lecture.

**Learning Structure:**



Serial No.	Activities	Hours
01	<p><b>Industrial Visits</b> Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the term work. <b>Two</b> industrial visits may be arranged in the following areas / industries to observe - Material Handling System, quality control charts / production record / layout flow systems / Facilities / Hydraulic &amp; pneumatic systems / Working of Boilers and steam engineering applications.</p> <ul style="list-style-type: none"> <li>i) Auto / Electronic equipment manufacturing industry.</li> <li>ii) Cement / Sugar / Chemical / Textile / Steel rolling mills / extrusion industries.</li> <li>iii) Material handling in mines or ports.</li> <li>iv) Earth Moving Equipment Maintenance Shop.</li> </ul>	21
02	<p>Lectures by Professional / Industrial Expert / Student Seminars based on information search to be organized from any of the following areas (four lectures of two hour duration) student shall submit the report on each lecture:</p> <ul style="list-style-type: none"> <li>a) Battery and its charging system</li> <li>b) Electronic ignition system</li> <li>c) Microprocessor based instrumentation in Automobiles</li> <li>d) Earth moving machines.</li> <li>e) Tractors</li> <li>f) Excavators.</li> <li>g) Fork lift truck.</li> <li>h) Road- roller.</li> <li>i) Automated Guided Vehicles (AGV)</li> <li>j) Career opportunities in Service stations, Marketing, Surveyor, Insurance, R&amp;D, call centers, CAD, NDT, Railways, Defense, Aeronautics, Marine, Software development, Information Technology,</li> <li>k) Continuing education / Open universities programmes,</li> <li>l) Air compressor technology</li> <li>m) Tribological Aspects in automobiles / machine tools</li> </ul>	16
03	<p><b>Group Discussion: (Two topics)</b> The students shall discuss in group of six to eight students and write a brief report on the same as a part of term work. The topic for group discussions may be selected by the faculty members. Some of the suggested topics are –</p> <ul style="list-style-type: none"> <li>i) Solar Vehicles / Electric Vehicles.</li> <li>ii) Auto Vehicles – Comparison.</li> <li>iii) Two stroke versus four stroke engines</li> <li>iv) Recycling of plastics and other waste material</li> <li>v) Attributes of product design</li> <li>vi) Creativity and innovativeness</li> <li>vii) Energy conservation in institutes</li> <li>viii) Value engineering</li> <li>ix) Revolution in communication technology</li> <li>x) Pneumatic tools and equipments</li> <li>xi) Wear mechanisms</li> </ul>	12

04	<p><b>Student Activities:</b> The students in a group of 3 to 4 will perform <b>ANY THREE</b> of the following activities (other similar activities to be considered), and write a report as a part of term work.</p> <p>Activity :</p> <ul style="list-style-type: none"> <li>i) Collecting internal communication forms.</li> <li>ii) Collecting Failure data for automobile / machines / equipments.</li> <li>iii) Study of Hydraulic system for any one application like – dumpers, Earth moving equipment, Auto service station.</li> <li>iv) Survey of oils used for hydraulic circuits – specifications, properties, costs, manufacturers names etc.</li> <li>v) Study any one type of CNC machining center and prepare report on tooling and tool holding devices</li> <li>vi) Using finite element method analyse stresses in a cantilever beam. Write all the steps involved with brief description.</li> <li>vii) For a given job write a sequence of operations performed by automated manufacturing system. Draw a block diagram of control system to perform above operations</li> <li>viii) Survey of types of bearings involving information about construction working principles, mounting, lubrication, materials, advantages, limitations and cost.</li> <li>ix) Prepare a trouble shooting chart for any refrigeration system and suggest remedial measures to avoid failures</li> <li>x) For a drilling or milling operations on a simple machine component, draw a jig or fixtures showing various features like locating clamping, fool proofing etc.</li> <li>xi) Compare non traditional methods on the basis of working principles, accuracy , MRR, Applications and limitations a) EBM b) PAM C)AJM d)WJM</li> <li>xii) For a given job involving 3 to 4 operations suggest to</li> </ul>	18
05	<p><b>Seminar:</b> Seminar on any advanced technical topic to be presented by individual student in a batch of 20 students. A separate topic be selected by an individual student</p>	13
<b>Total</b>		<b>80</b>

**Course Name : Mechanical Engineering Group**

**Course Code : ME/MH/MI/AE/PG/PT**

**Semester : Sixth for ME/AE/PG/PT and Seventh for MH/MI**

**Subject Title : Alternate Energy Sources and Management (Elective-II)**

**Subject Code : 12244**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

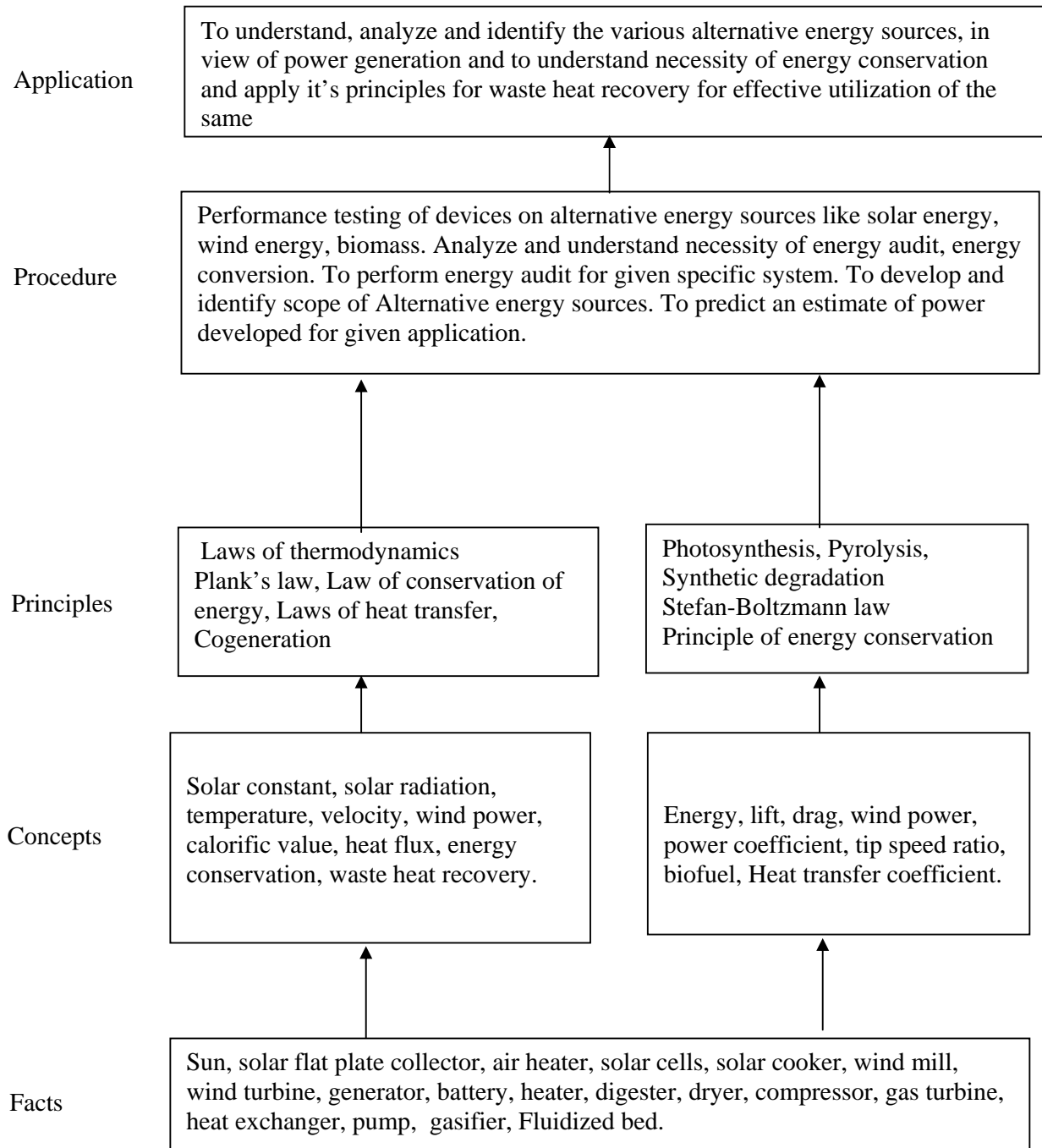
**Rationale:**

Energy is an important aspect in all sectors of country's economy. The energy crisis is mainly caused due to increased population and enhanced standard of living and life style of people. The conventional sources of energy are insufficient to meet these demands. These are polluting the environment disturbing ecobalance. Hence, alternative energy sources are utilized for power production. The use of alternate energy sources is increasing day by day. Diploma engineers are expected to develop, operate and maintain these systems. It is therefore essential to know basics of energy conversion, conservation, and energy audit and waste heat recovery techniques.

**Objectives:**

Students should be able to:

1. Develop awareness for effective utilization of alternative energy sources.
2. Identify different components of solar energy and wind energy devices.
3. Identify and analyze biomass plant.
4. Identify and apply energy conservation techniques for commonly used power absorbing and generating devices.
5. Apply principles of energy conservation and energy management techniques.
6. Develop awareness about Energy Audits.

**Learning Structure:-**



**Contents: Theory:**                      **Note: one assignment at Sr. No. 3 is added**

Chapter	Name of the Topic	Hours	Marks
01	<b>Introduction to Energy Sources</b> 1.1 Introduction. 1.2 Major sources of energy: Renewable and Non-renewable. 1.3 Primary and secondary energy sources. 1.4 Energy Scenario: <ul style="list-style-type: none"> <li>• Prospects of alternate energy sources.</li> <li>• Need of Alternate energy sources.</li> </ul>	06	12
02	<b>Solar Energy</b> 2.1 Principle of conversion of solar energy into heat and electricity 2.2 Solar Radiation: Solar Radiations at earth's surface <ul style="list-style-type: none"> <li>• Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle</li> </ul> 2.3 Applications of Solar energy: - <ul style="list-style-type: none"> <li>• Construction and working of typical flat plate collector and solar concentrating collectors and their applications,</li> <li>• advantages and limitations</li> <li>• Space heating and cooling.</li> <li>• Photovoltaic electric conversion.</li> <li>• Solar distillation, Solar cooking and furnace.</li> <li>• Solar pumping and Green House.</li> <li>• Agriculture-Solar drying for foods</li> <li>• (no derivations and numerical)</li> </ul>	12	20
03	<b>Wind Energy</b> 3.1 Basic Principle of wind energy conversion. 3.2 Power in wind, Available wind power formulation, Power coefficient, Maximum power 3.3 Main considerations in selecting a site for wind mills. <ul style="list-style-type: none"> <li>• Advantages and limitations of wind energy conversion.</li> </ul> 3.4 Classification of wind mills <ul style="list-style-type: none"> <li>• Construction and working of horizontal and vertical axis wind mills, their comparison</li> <li>• Main applications of wind energy for power generation and pumping.</li> </ul>	08	14
04	<b>Energy from Biomass</b> 4.1 Common species recommended for biomass. <ul style="list-style-type: none"> <li>• Methods for obtaining energy from biomass</li> </ul> 4.2 Thermal classification of biomass <ul style="list-style-type: none"> <li>• Gasifier,</li> <li>• Fixed bed and fluidized</li> <li>• Application of gasifier</li> </ul> 4.3 Biodiesel properties, production and application 4.4 Agriculture waste as a biomass <ul style="list-style-type: none"> <li>• Biomass digester</li> </ul>	06	14

	<ul style="list-style-type: none"> <li>• Comparison of Biomass with conventional fuels</li> </ul>		
05	<b>Energy Conservation &amp; Management</b> 5.1 Energy scenario in various sectors and Indian economy 5.2 Need and importance of energy conservation and management 5.3 Concept of Payback period, Return on investment (ROI), Life cycle cost, Sankey diagrams, specific energy consumption.	04	12
06	<b>Energy Conservation Techniques</b> 6.1 Distribution of energy consumption <ul style="list-style-type: none"> <li>• Principles of energy conservation.</li> <li>• Energy audit</li> <li>• Types of audit</li> </ul> 6.2 Methods of energy conservation <ul style="list-style-type: none"> <li>• Cogeneration and its application</li> <li>• Combined cycle system</li> </ul> 6.3 Concept of energy management 6.4 Study of different energy management techniques like <ul style="list-style-type: none"> <li>• Analysis of input</li> <li>• Reuse and recycling of waste</li> <li>• Energy education</li> <li>• Conservative technique and energy audit</li> </ul>	06	16
07	<b>Economic approach of Energy Conservation</b> 7.1 Costing of utilities like steam, compressed air, electricity and water. <ul style="list-style-type: none"> <li>• Ways of improving boiler efficiency</li> </ul> 7.2 Thermal insulation, Critical thickness of insulation 7.3 Waste heat recovery systems, their applications, criteria for Installing unit. 7.4 An introductory approach of energy conservation in compressed air, refrigeration, air conditioning, pumps and fans.	06	12
<b>Total</b>		<b>48</b>	<b>100</b>

**Assignments:**

- 1) To collect information about global and Indian energy market.
- 2) To perform an experiment on solar flat plate collector used for water heating.
- 3) To study and analyze performance of Solar street lighting System.
- 4) To study construction and working of photo voltaic cell.
- 5) To study construction, working and maintenance of solar cooker.
- 6) Visit to plant of solar heating system for hotel/hostel/railway station etc.
- 7) To study construction and working of horizontal axis wind mill or to visit a nearest wind farm.
- 8) To visit a biomass/ biogas plant of municipal waste or else where.
- 9) Perform energy audit for workshop/Office/Home/SSI unit.

10) Study of various waste heat recovery devices.

**Learning Resources:**

**1. Books:**

<b>Author</b>	<b>Title</b>	<b>Publication</b>
Dr B.H.Khan	Non conventional energy Resources	Tata McGraw Hill
G. D. Rai	Non conventional energy sources	Khanna publication
S. P. Sukhatme	Solar energy	Tata McGraw Hill
H. P. Garg	Solar energy	Tata McGraw Hill
Arrora Domkundwar	Power plant engineering	Dhanpat Rai & co.
P.H. Henderson	India- The energy sector	University Press
D. A. Ray	Industrial energy conservation	Pergaman Press
W. C. Turner	Energy management handbook	Wiley Press
K. M. Mittal	Non-conventional energy source	--
Krupal Singh Jogi	Energy resource management	Sarup and sons

**2. Cassettes/CD/websites:**

1. CDs developed by National Power Training Institute, (Under the ministry of Power, Government of India) Opposite VNIT, South Ambazari road, Nagpur
2. Website of Bureau of Energy and Efficiency. ([www.bee-india.nic.in](http://www.bee-india.nic.in))
3. Website for Akshay Urja News Bulletin. ([www.mnes.nic.in](http://www.mnes.nic.in))

**Course Name : Diploma in Mechanical Engineering**

**Course Code : ME/MH/MI**

**Semester : Sixth for Me and Seventh For MH/MI**

**Subject Title : Material Handling System (Elective-II)**

**Subject Code : 12245**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

**Rationale:**

Material handling equipment is an integral part of modern industrial enterprise. The flow of material in industry depends on a rational choice of the material handling equipment, correct determination of its main parameters and efficient operation. Every diploma technician must know the operational features of the equipment & its practical application.

Carrying parts & products in a shop from one work station to another, transferring them from shop to shop or taking care of stockpiling and reclaiming operations, material handling equipment/systems enable the process to go on without interruptions & at a predetermined pace.

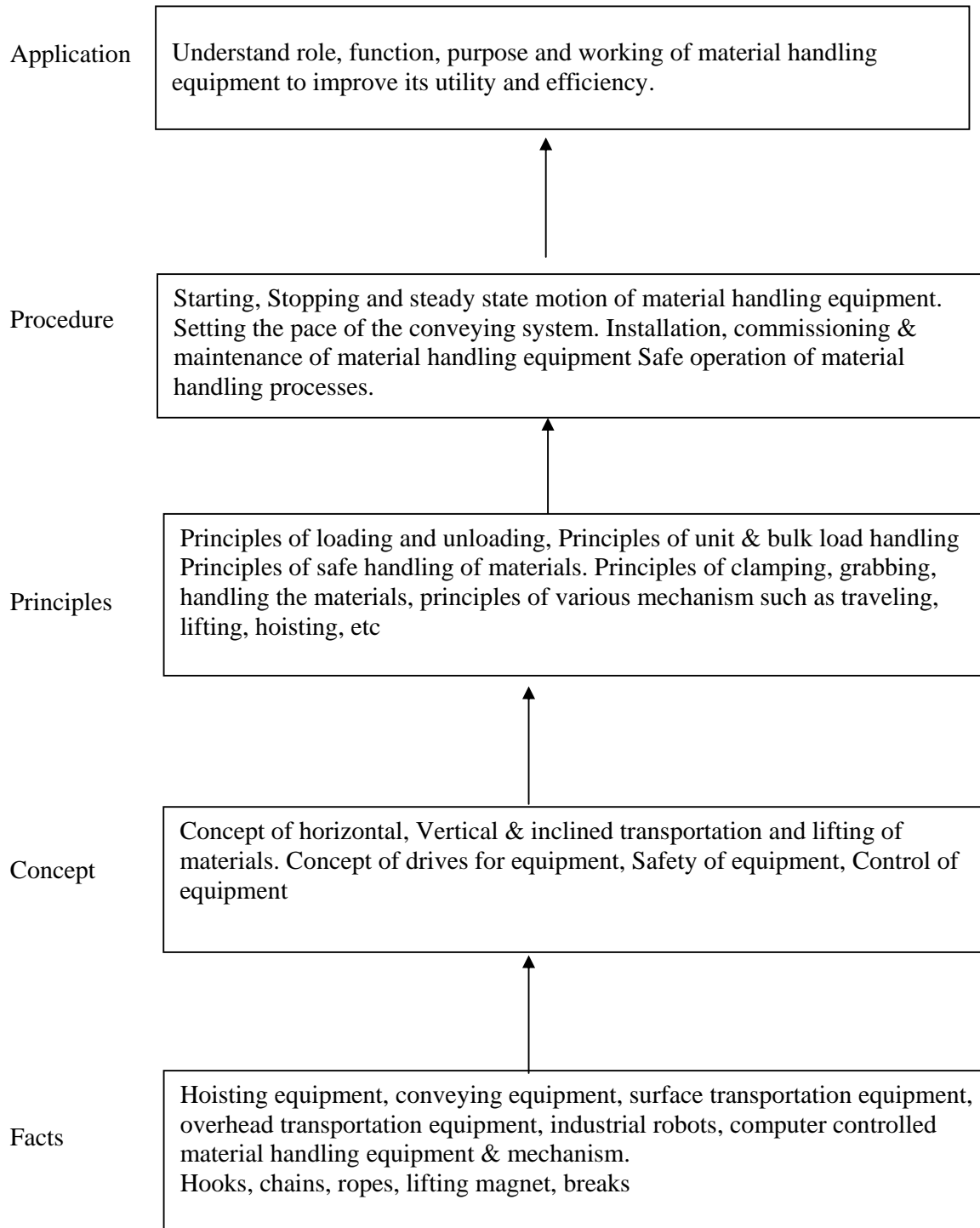
Knowledge of the subject will help technician to understand, select, operate and maintain the material handling equipments.

**Objectives:**

The student will be able to.

- 1) Understand constructional & operational features of various materials handling systems.
- 2) Identify, compare & select proper material handling equipment for specified applications.

- 3) Know the controls & safety measures incorporated on material handling equipment.
- 4) Understand different material handling processes used in industries.
- 5) Appreciate the role of material handling devices in mechanization & automation of industrial process.

**Learning Structure:**

**Contents: Theory**

**Notes:** 1) Design aspects of material handling equipment are to be ignored.

2) No derivations & mathematical treatment.

Chapter	Name of topic	Hours	Marks
01	<b>Introduction to Material Handling System</b> Main types of material handling equipments & their applications, types of load to be handled, types of movements, methods of stacking, loading & unloading systems, principles of material handling systems.	04	08
02	<b>Hoisting Machinery &amp; Equipments</b> 2.1 Construction, working & maintenance of different types of hoists such as lever operated hoist , portable hand chain hoist, differential hoists, worm geared and spur geared hoists, electric & pneumatic hoists, jumfer. 2.2 Construction, working & maintenance of different types of cranes such as rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes & cranes traveling on guide rails. 2.3 Construction, working & maintenance of elevating equipments such as stackers, industrial lifts, freight elevators, passenger lifts, mast types elevators, vertical skip hoist elevators.	12	24
03	<b>Conveying Machinery</b> 3.1 Construction, working & maintenance of traction type conveyors such as belt conveyors, chain conveyors, bucket elevators, escalators. 3.2 Construction, working & maintenance of traction less type conveyors such as gravity type conveyors, vibrating & oscillating conveyors, screw conveyors, pneumatic & hydraulic conveyors, hoppers gates & feeders.	06	12
04	<b>Surface Transportation Equipment</b> 4.1 Construction, function, working of trackless equipment such as hand operated trucks, powered trucks, tractors, AGV- Automatic Guided vehicle, industrial Trailers. 4.2 Construction, function, working of cross handling equipment such as winches, capstans, Turntables, Transfer tables, monorail conveyors.	08	16

05	<p><b>Components of material handling systems</b></p> <p>5.1 Flexible hoisting appliances such as welded load chains, roller chains, hemp ropes, steel wire ropes, fastening methods of wire &amp; chains, eye bolts ,lifting tackles lifting &amp; rigging practices.</p> <p>5.2 Load handling attachments.</p> <p>a) Various types of hooks-forged, triangular eye hooks, appliances for suspending hooks,</p> <p>b) Crane grab for unit &amp; piece loads</p> <p>c) Electric lifting magnet, vacuum lifter.</p> <p>d) Grabbing attachment for loose materials</p> <p>e) Crane attachment for handling liquids / molten metals</p> <p>5.3 Arresting gear &amp; Brakes.</p> <p>a) Arresting gear – construction &amp; working</p> <p>b) Construction &amp; use of electromagnetic shoe brakes Thruster operated shoe brakes, control brakes.</p>	08	18
06	<p><b>Mechanism used in material handling equipment</b></p> <p>6.1 Steady state motion, starting &amp; stopping of motion in following mechanisms.</p> <ul style="list-style-type: none"> <li>- Hoisting mechanism</li> <li>- Lifting Mechanism</li> <li>- Traveling Mechanism</li> <li>- Slewing Mechanism</li> <li>- Rope &amp; chain operated Cross- Traverse Mechanism.</li> </ul>	06	12
07	<p><b>Selection of material handling equipment</b></p> <p>Factors affecting choice of material handling equipment such as type of loads, hourly capacity of the unit, direction &amp; length of travel, methods of stocking at initial, final &amp; intermediate points, nature of production process involved, specific load conditions &amp; economics of material handling system.</p>	04	10
<b>Total</b>		<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills**

1. Understand the working principle of equipment/devices.
2. Identify & name major component of material handling device.
3. Understand role of material handling equipment in the industrial process.
4. Understand & appreciate safety instrumentation for equipment.

**Motors skills**

- 1) Identify & select the material handling devices for a given application.
- 2) Operate the working model of material handling equipment.

- 3) Ability to implement preventive maintenance schedule of material handling devices.

**List of Practical:**

- 1) Study & demonstration of any one type of conveyor – belt, Screw, pneumatic, hydraulic.
- 2) Study and demonstration of any one type of crane (working model or actual).
- 3) Study and demonstration of fork lift truck (using electric drive or diesel engine) Or hoisting equipment.
- 4) Study of preventive maintenance schedule of any one major material handling equipment using operation manual.
- 5) Visit to coal handling plant of thermal power plant or cement industry to observe working of different types of bulk material handling devices (at least three equipments). Write report of the visit.

OR

Visit to steel industry or automobile manufacturing unit or sugar industry to observe different types of roller conveyors, Bucket elevators, overhead cranes load handling attachments, electric lifting magnet (at least 3 equipments). Write report of the visit

**List of Practice Oriented Projects:**

Note: Select any one mini project from following and submit report of the same (min. 5 pages)

1. Collect and write detail specifications of any two major material handling devices.
2. Collect and write information about manufacturer, Cost, Capacity range, availability, application of any one material handling equipment from the following.
  - a) Hoisting equipment.
  - b) Conveying equipment.
  - c) Surface transportation equipment.
3. Collect photographs of ten different types of cranes used in industries. Write name and specific utility of each.
4. Collect photographs of ten different types of conveyers used in industries. Write name and specific utility of each
5. Write name of material handling devices and their utility after visiting any big industry near by area
6. Using internet collects and writes information about six major manufacturer of material handling equipment



7. Write report about testing of overhead crane for its lifting capacity.

**Learning Resources:-**

**Books:**

Sr. No	Author	Title	Publisher
01	N. Rundenko	Material handling equipment	Peace Publisher, Moscow
02	M. P. Alexandrov	Material handling equipment	MIR Publisher, Moscow
03	Y. I. Oberman	Material handling	MIR Publisher, Moscow
04	R. B. Chowdary & G. R. N. Tagore	Material handling equipment	Khanna Publisher, Delhi
05	Allegri T. H.	Material handling (Principles & Practice)	CBS Publisher, Delhi
06	Apple j. M	Plant layout & materials handling	JohnWiley Publishers.
07	Bolz and others	Material handling Hand book	--
08	Daylas R. W. Pergaman, Berlin	Encyclopedia of materials handling	--
09	Immer J. R.	Material handling	Mc Graw Hill, New York
10	Parameswaran M. A.	Material handling equipment	C.D.C. in Mechanical Engg., I.I.T., Chennai

**Course Name : Diploma in Mechanical Engineering**

**Course Code : ME/MH/MI**

**Semester : Sixth for ME and Seventh for MH/MI**

**Subject Title : Refrigeration and Air Conditioning (Elective-II)**

**Subject Code : 12246**

**Teaching and Examination Scheme:-**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

**Rationale:**

This subject is classified as an Applied Technology. The 21<sup>st</sup> century predicts revolutionary developments in Refrigeration and Air Conditioning. Refrigeration and Air conditioning is one of the most meaningful job areas for diploma holders in Mechanical Engineering. Considering the wide and increasing use of Refrigeration and Air conditioning for domestic, commercial and industrial applications and the challenges put by the use of Refrigeration and air conditioning equipments in existing stage, it is absolutely necessary that Diploma Engineers should learn this subject. They should know the processes, equipments, systems of Refrigeration and Air Conditioning with their functioning, maintenance, repairs and measures to meet the challenges of the near future in this area. The Knowledge of Thermal Engineering and Power Engineering is a prerequisite for this subject.

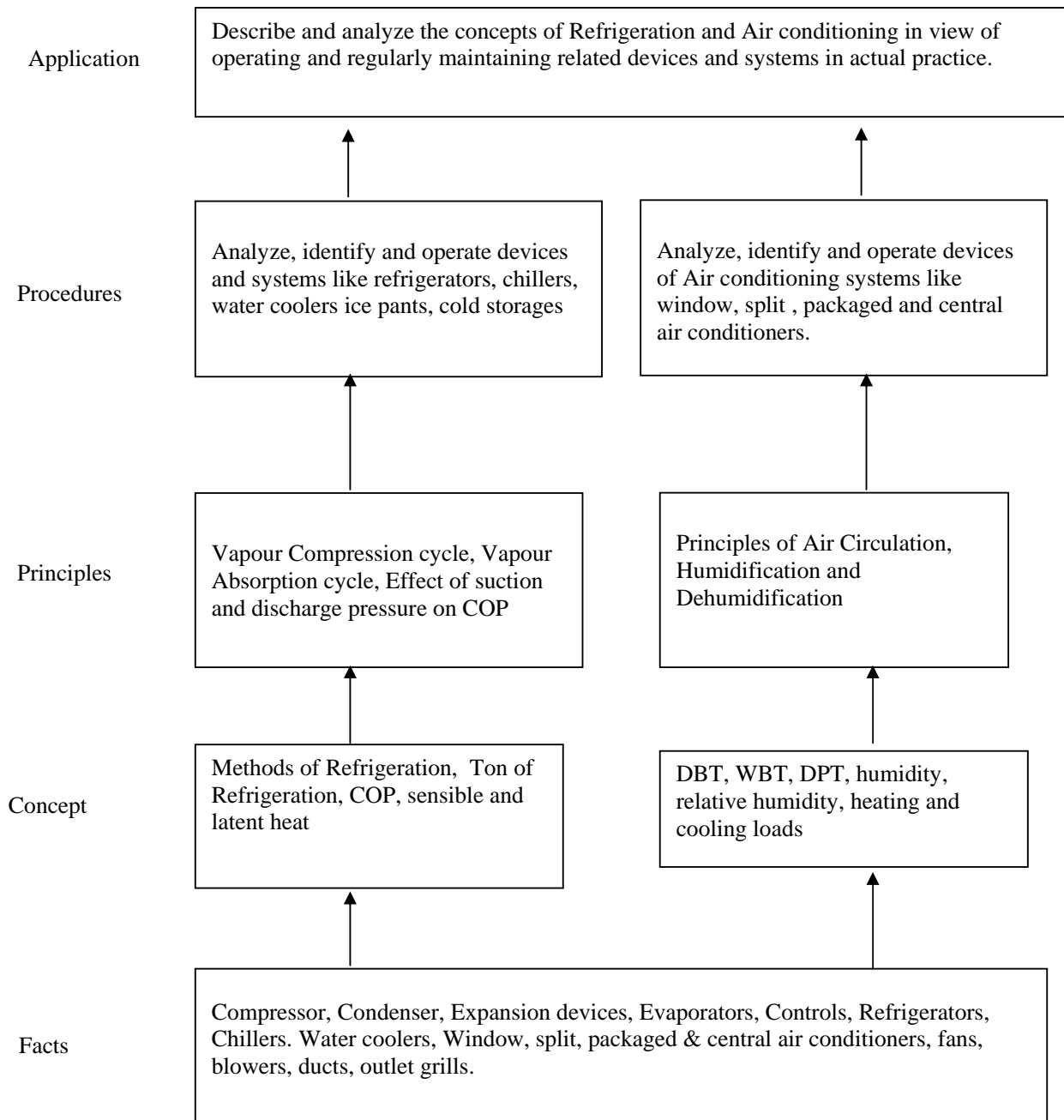
**Objectives:**

The student should be able to: -

1. Describe types, working principles and construction of Refrigeration and Air Conditioning systems.
2. Calculate performance of refrigeration and air conditioning system.
3. Use various charts and tables used in refrigeration and air conditioning.
4. Enlist properties of refrigerants, their applications and effects on environment.
5. Identify various components and controls used in refrigeration and air conditioning.

6. Describe various air conditioning systems and their applications.
7. Estimate cooling and heating loads.
8. Identify and describe different components of air distribution system.

**Learning Structure: -**



**Contents: Theory**

<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
01	<p><b>Basics of Refrigeration</b></p> <p>1.1 a) Definition of refrigeration. b)Necessity of refrigeration c) Unit of refrigeration, C.O.P. and refrigerating effect. d) Concept of heat engine, heat pump and refrigerator.</p> <p>1.2 Methods of refrigeration:- Ice refrigeration Refrigeration by expansion of air Refrigeration by throttling of gas Vapour refrigeration system Steam jet refrigeration system Non conventional methods of refrigeration like Vortex tube, Pulse tube refrigeration, solar refrigeration</p> <p>1.3 Major application areas of R.A.C. like domestic, commercial and industrial.</p>	06	12
02	<p><b>Refrigeration Cycles</b></p> <p>2.1 a) Reversed Carnot Cycle and its representation on PV and TS diagram. b)Air Refrigeration Cycles: - - Bell Coleman air refrigerator, it's representation on PV and TS diagram, types and applications like air craft refrigeration using simple air cooling system.. - (Simple numerical on Reversed Carnot cycle.)</p> <p>2.2 Vapour Compression Cycle (V.C.C): - - principle, components, Representation on P-H and T-S diagram, effects of wet compression, dry compression, calculation of COP, Effect of superheating, under cooling, suction pressure and discharge pressure, Actual V.C.C., (simple numerical), Methods of improving COP (no description). - Introduction to multistage V.C.C., its necessity, advantages.</p> <p>2.3 Vapour Absorption system : - - Principle, components and working of aqua-ammonia system (simple &amp; practical) Li-Br Absorption System Electrolux Refrigeration System, Desirable properties of Refrigerant and absorbent used in Vapour Absorption System.</p> <p>Comparison of vapour compression refrigeration system and vapour absorption refrigeration system.</p>	10	20
03	<p><b>Refrigerants</b></p> <p>3.1 a) Classification of refrigerants. b) Desirable properties of refrigerants.</p> <p>3.2 a) Nomenclature of refrigerants.</p>	04	08

	<p>b) Selection of refrigerant for specific applications.</p> <p>3.3 a) Concept of Green House Effect, Ozone depletion, Global warming.</p> <p>3.3 b) Eco-friendly refrigerants like R-134a, hydrocarbon refrigerants etc.</p>		
04	<p><b>Equipment selection</b></p> <p>4.1 Components of Vapour Compression Refrigeration System</p> <p>a) Compressors:</p> <ul style="list-style-type: none"> <li>- Classification, Construction and working of open type, hermetic, centrifugal, rotary, screw and scroll compressor and their applications.</li> </ul> <p>b) Condensers:</p> <ul style="list-style-type: none"> <li>- Classification, description of air cooled and water cooled condensers, comparison and applications</li> <li>- Evaporative condensers.</li> </ul> <p>c) Expansion devices:</p> <ul style="list-style-type: none"> <li>- Types: - Capillary tube, automatic thermostatic expansion valve and their working principle &amp; applications</li> </ul> <p>d) Evaporators and chillers: -</p> <ul style="list-style-type: none"> <li>- Classification of evaporators Construction and working of Bare tube, Plate surface, finned, shell and tube, flooded and dry expansion evaporator</li> <li>- Capacity of evaporator and their applications</li> <li>- Classification of chillers</li> <li>- Construction and working of dry expansion Chillers and flooded chillers and their applications.</li> </ul> <p>4.2 Selection criteria for Vapour compression refrigeration system components for the following applications: Water coolers, ice plants, cold storage, domestic refrigerator</p>	10	20
05	<p><b>Psychrometry</b></p> <p>5.1 a) Definition and necessity of air conditioning.</p> <p>b) Properties of Air, Dalton's law of partial pressure</p> <p>5.2 a) Psychrometric chart</p> <p>b) Psychrometric processes, Bypass Factor, ADP, concept of SHF, RSHF, ERSHF, GSHF</p> <p>c) Simple numerical using Psychrometric chart</p> <p>d) Adiabatic mixing of Air streams</p> <p>5.3 Equipments used for Air- conditioning like humidifier, dehumidifier, filter, heating and cooling coils.</p>	06	12
06	<p><b>Comfort conditions and cooling load calculations</b></p> <p>6.1 a) Thermal exchange of body with environment</p> <p>b) Factors affecting human comfort</p> <p>c) Effective temp. and comfort chart</p> <p>6.2 Components of cooling load- sensible heat gain and latent heat gain sources, calculation of cooling load (No numericals)</p>	04	12

07	<b>7.1 Air- conditioning systems</b> a) Classification of A.C. systems b) Industrial and commercial A.C. systems c) Summer, winter and year round A.C. systems d) Central and unitary A.C. systems 7.2 Application areas of A.C. systems	04	08
08	<b>Air distribution systems</b> 8.1 Duct systems: - a) Closed perimeter system, extended plenum system, radial duct system, duct materials, requirement of duct materials, losses in ducts b) Air distribution outlets: - - Supply outlets, return outlets, grills, diffusers c) Fans and Blowers: - - Types, working of fans and blowers 8.2 Insulation: - - Purpose, properties of insulating material, types of insulating materials, methods of applying insulation.	04	08
<b>Total</b>		<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. Identify various components of refrigeration and air conditioning equipment
2. Analyse cooling load based on application.
3. Interpret psychometric chart to find various properties of air.
4. Observe working of test rigs and calculate coefficient of performance.

**Motor Skills:**

1. Handle various tools used for refrigeration and air conditioning plant maintenance
2. Use of temperature, pressure, energy measuring devices
3. Draw the layout of central Air conditioning plant
4. Perform cooling load calculations for different air conditioning applications
5. Select and use of different types of insulating material and setting procedures for applying insulations

**List of Practical:**

1. Trial on water cooler test rig.
2. Trial on ice plant test rig.
3. Visit to cold storage
4. Demonstration of domestic refrigerator in View of construction, operation and controls used.
5. Demonstration of various controls like L.P./H.P. cut outs, thermostat, overload protector, solenoid valve used in RAC.
6. Identification of components of 'hermetically sealed compressor'.
7. Visit to repair and maintenance workshop in view of use of various tools and charging procedure.

8. Cooling load calculations for cabin, classrooms, laboratory, canteen and dairy plant, milk storage, small freezers (minimum one).
9. Trial on A.C. test rig.
10. Visit to central A.C. plant in view of ducting system, insulation system and Air distribution system (e.g. frozen food industry/ice- cream industry/mushroom plants/textile industries).
11. Trouble shooting of domestic refrigerator/window air- Conditioner.

### Learning Resources:

#### 1. Books:

Sr. No	Author	Tit;e	Publisher
01	R.S.Khurmi	Refrigeration and Air Conditioning	S.Chand and Co
02	Arrora and Domkundwar	Refrigeration and Air Conditioning	Dhanpat Rai and Sons
03	Manohar Prasad	Refrigeration and Air Conditioning	New Age Publications
04	P.N.Ananthanarayanan	Refrigeration and Air Conditioning	Tata McGraw Hill
05	Roy Dossat	Principles of Refrigeration	Pearson Education
06	Edwin P. Anderson	Commercial Refrigeration	Taraporevala Sons & Co

#### 2. IS/International Codes/Publications:

- a) ISHRAE handbooks
- b) Manohar Prasad: Refrigeration and Air Conditioning hand book, New Age Publications.

**Course Name : Mechanical Engineering Group**

**Course Code : ME/AE/MH/MI/PG/PT/PS**

**Semester : Sixth for ME/AE/PG/PT/PS and Seventh for MH/MI**

**Subject Title : Cad-Cam & Automation (Elective – II)**

**Subject Code : 12247**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

**NOTE:**

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

**Rationale:**

The need of today's manufacturing industrial world is based on best quality & precision oriented shorter manufacturing cycle time .To satisfy this need the use of CAD/CAM & automation is inevitable .To satisfy industrial need, diploma engineer should be able to cope with CAD/CAM technology. With this intention this subject is introduced in the curriculum. The prerequisites of this subject have been introduced in earlier subjects such as engineering graphics, engineering drawing & mechanical engineering drawing.

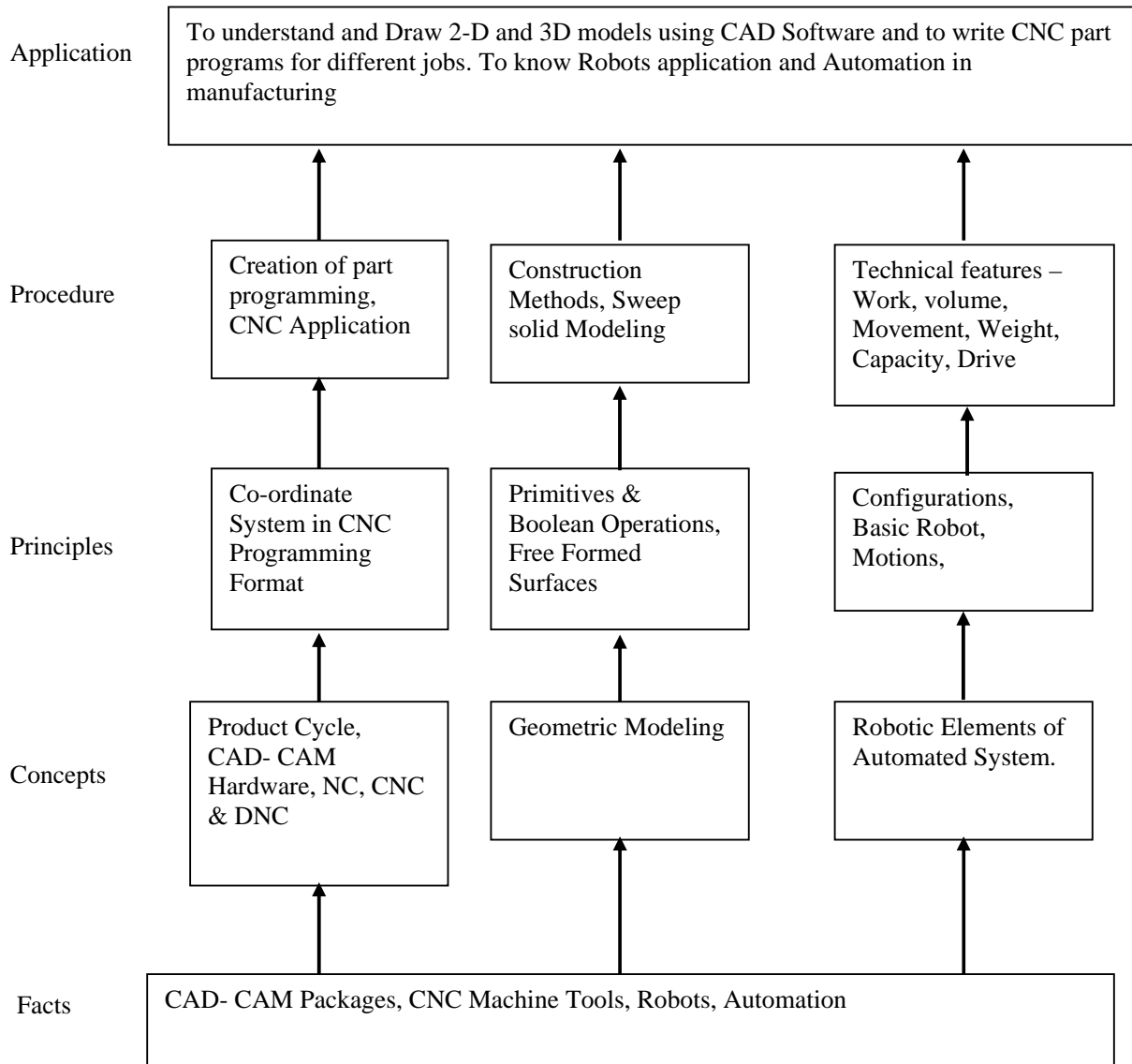
**Objectives:**

Student should be able to:

1. Understand the fundamentals & use CAD.
2. Conceptualize drafting and modeling in CAD.
3. Prepare CNC part programming.
4. Operate CNC machines.
5. Conceptualize automation and FMS.



**Learning Structure:**



**Contents: Theory**

<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
01	<b>Introduction to CAD/CAM</b> Role and Need of Computers in industrial manufacturing. Product Cycle, CAD/CAM. CAD/CAM hardware:- Basic structure, CPU, Memory, I/O devices, Storage devices and system configuration.	06	12
02	<b>Geometric Modeling</b> Requirement of geometric modeling, Types of geometric models. Geometric construction methods:-sweep, solid modeling-Primitives & Boolean operations, free formed surfaces (Classification of surface only), Rapid Prototyping (No numerical treatment)	08	16
03	Introduction to computer numerical Control Introduction - NC, CNC, DNC, Advantages of CNC, The coordinate system in CNC, Motion control system - point to point, straight line, Continuous path (Contouring). Absolute system and Incremental system, Feedback control system, Application of CNC.	06	16
04	<b>Part programming</b> Fundamentals, manual part programming, NC –Words, Programming format, part programming, use of subroutines and do loops, computer aided part programming (APT).	10	20
05	<b>Industrial Robotics</b> Introduction, Types of Robots and their working principle, physical configuration, basic robot motions, technical features such as - work volume, precision and speed of movement, weight carrying capacity, drive system, End effectors, robot sensors. Applications – Material transfer, machine loading, welding, spray coating, processing operation, assembly, inspection.	10	20
06	<b>Automation</b> Basic elements of automated system, advanced automation functions, levels of automation. Flexible manufacturing system :-Introduction, Scope and benefits, Types, Major elements of FMS, FMS equipment, FMS application, Introduction to CIM Lean Manufacturing :- Introduction	08	16
<b>Total</b>		<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. Interpret the various features in the menu of solid modeling package.
2. Synthesize various parts or components in an assembly.
3. Prepare cnc programmes for various jobs.

4. Understand the concept of finite element method.
5. Prepare a report of visits.

**Motor Skills:**

1. Operate a turning center and a machining center.
2. Operate and use solid modeling packages for drawing of assemblies.
3. Draw sketches of assemblies for converting into solid models.
4. Handle various tools used in cnc.

**List of Practicals:**

1. Two assignments on CAD for 2D drafting.
2. Two assignments on CAD for 3D Modelling.
3. Manufacturing one turning and one Milling component on CNC.
4. At least four assignments on part programming using subroutines do loops for turning and milling component.
5. Report writing on visit to industry having CNC machine.
6. Report writing on visit to industry having robot Application.
7. Report writing on visit to Industry having Automation in manufacturing.

**Learning Resources:****Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publication</b>
01	P.N.Rao	CAD/CAM Principles and Applications	Tata McGraw-Hill
02	RadhaKrishna P. & Subramanyam	CAD/CAM/CIM	Wiley EasternLtd
03	B.S.Pabla and M.Adithan	CNC Machine	New age International(P)Ltd
04	Groover M.P. & Zimmers Jr	Computer Aided design and manufacturing	Prentice hall of India