 <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 AUTOMOBILE ENGINEERING</b>																
<b>COURSE CODE : AE</b>																
<b>DURATION OF COURSE : 6 SEMESTERS</b>										<b>WITH EFFECT FROM 2012-13</b>						
<b>SEMESTER : FOURTH</b>										<b>DURATION : 16 WEEKS</b>						
<b>PATTERN : FULL TIME - SEMESTER</b>										<b>SCHEME : G</b>						
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									SW (17400)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)		
								Max	Min	Max	Min	Max	Min	Max	Min	
1	Environmental Studies \$	EST	17401	01	--	02	01	50#*	20	--	--	--	--	25@	10	<b>50</b>
2	Automobile Manufacturing Processes	AMP	17403	03	--	02	03	100	40	--	--	--	--	25@	10	
3	Heat Power Engineering	HPE	17407	03	--	02	03	100	40	--	--	25 #	10	25@	10	
4	Automobile Engines	AEN	17408	03	--	04	03	100	40	50#	20	--	--	25@	10	
5	Automobile Systems and Body Engineering	ASB	17409	03	--	02	03	100	40	25 #	10	--	--	25@	10	
6	Theory of Machines β	TOM	17412	03	--	02	03	100	40	--	--	--	--	25@	10	
7	Professional Practices-II	PPT	17035	--	--	02	--	--	--	--	--	--	--	50@	20	
<b>TOTAL</b>				<b>16</b>	<b>--</b>	<b>16</b>	<b>--</b>	<b>550</b>	<b>--</b>	<b>75</b>	<b>--</b>	<b>25</b>	<b>--</b>	<b>200</b>	<b>--</b>	<b>50</b>
<b>**</b>	<b>Industrial Training (Optional)</b>			<b>Examination in 5<sup>th</sup> Semester Professional Practices-III</b>												
Student Contact Hours Per Week: <b>32 Hrs.</b> <b>THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.</b> Total Marks : <b>900</b> @ - Internal Assessment, # - External Assessment, <span style="background-color: #cccccc; padding: 2px;"> </span> No Theory Examination, \$ - Common to all branches, #* - Online Examination, β - Common to ME, PG, PT, MH, MI Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work <b>** Industrial Training (Optional) - Student can undergo Industrial Training of four weeks after fourth semester examination during summer vacation.</b> <b>Assessment will be done in Fifth semester under Professional Practices-III. They will be exempted from activities of Professional Practices-III of 5<sup>th</sup> Semester.</b> <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 : AE/CE/CM/CO/CR/CS/CW/DE/EE/EP/IF/EJ/EN/ET/EV/EX/IC/IE/IS/  
ME/MU/PG/PT/PS/CD/CV/ED/EI/FE/IU/MH/MI/DC/TC/TX/FG/AU**

**Semester : Fourth**

**Subject Title : Environmental Studies**

**Subject Code : 17401**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
01	--	02	01	50#*	--	--	25@	75

**#\* Online Theory Examination**

**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:**

Environment essentially comprises of our living ambience, which gives us the zest and verve in all our activities. The turn of the twentieth century saw the gradual onset of its degradation by our callous deeds without any concern for the well being of our surrounding we are today facing a grave environmental crisis. The unceasing industrial growth and economic development of the last 300 years or so have resulted in huge ecological problems such as overexploitation of natural resources, degraded land, disappearing forests, endangered species, dangerous toxins, global warming etc.

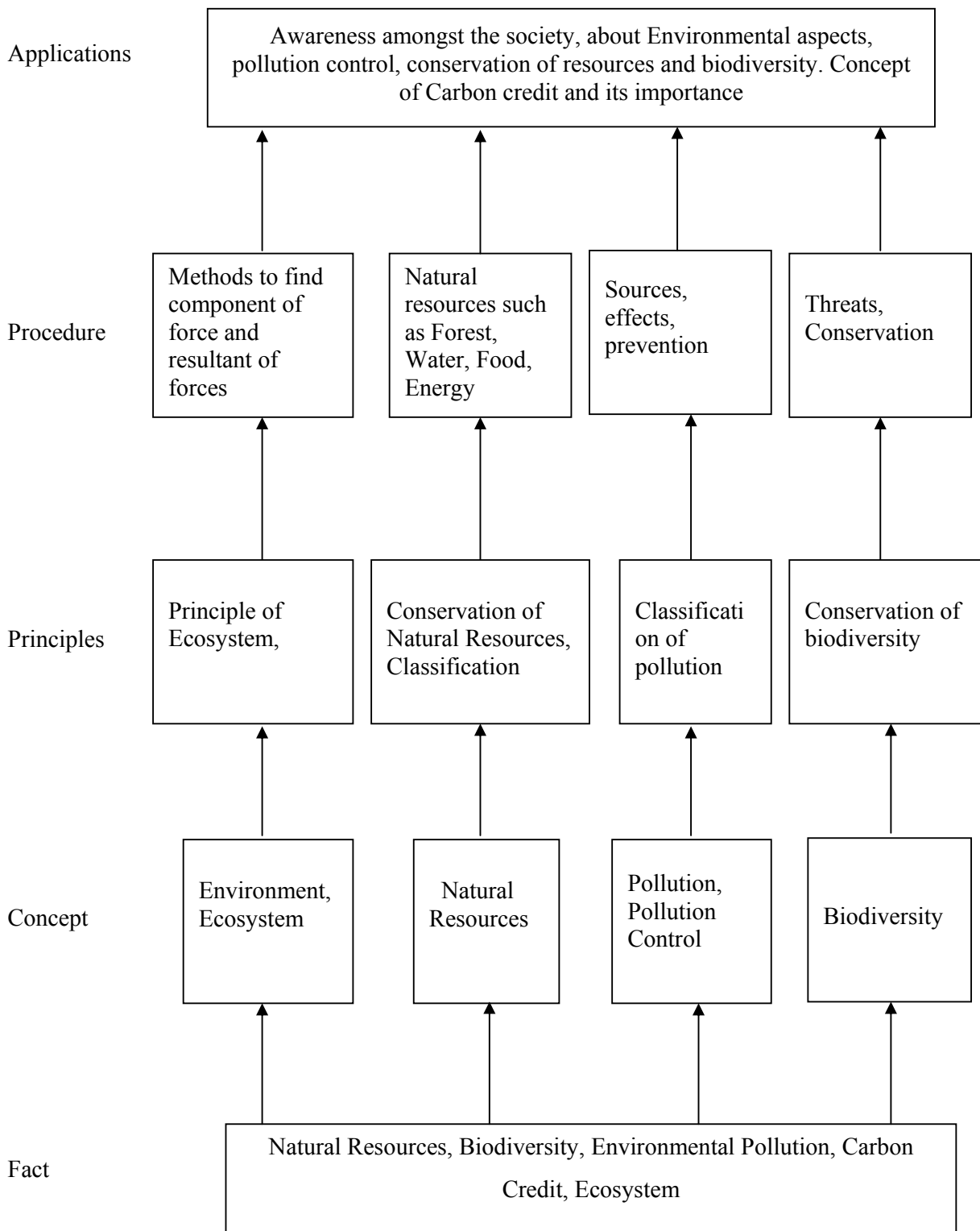
It is therefore necessary to study environmental issues to realize how human activities affect the environment and what could be possible remedies or precautions which need to be taken to protect the environment.

The curriculum covers the aspects about environment such as Environment and Ecology, Environmental impacts on human activities, Water resources and water quality, Mineral resources and mining, Forests, etc.

**General Objectives:** The student will be able to,

1. Understand importance of environment
2. Know key issues about environment
3. Understands the reasons for environment degradation
4. Know aspects about improvement methods
5. Know initiatives taken by the world bodies to restrict and reduce degradation

**Learning Structure:**



**Theory:**

<b>Topic and Contents</b>	<b>Hours</b>	<b>Marks</b>
<p><b>Topic 1: Nature of Environmental Studies</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Define the terms related to Environmental Studies</li> <li>➤ State importance of awareness about environment in general public</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Definition, Scope and Importance of the environmental studies</li> <li>• Importance of the studies irrespective of course</li> <li>• Need for creating public awareness about environmental issues</li> </ul>	01	04
<p><b>Topic 2: Natural Resources and Associated Problems</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Define natural resources and identify problems associated with them</li> <li>➤ Identify uses and their overexploitation</li> <li>➤ Identify alternate resources and their importance for environment</li> </ul> <p><b>Contents:</b></p> <p>2.1 Renewable and Non renewable resources</p> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Associated problems</li> </ul> <p>2.2 Forest Resources</p> <ul style="list-style-type: none"> <li>• General description of forest resources</li> <li>• Functions and benefits of forest resources</li> <li>• Effects on environment due to deforestation, Timber extraction, Building of dams, waterways etc.</li> </ul> <p>2.3 Water Resources</p> <ul style="list-style-type: none"> <li>• Hydrosphere: Different sources of water</li> <li>• Use and overexploitation of surface and ground water</li> <li>• Effect of floods, draught, dams etc. on water resources and community</li> </ul> <p>2.4 Mineral Resources:</p> <ul style="list-style-type: none"> <li>• Categories of mineral resources</li> <li>• Basics of mining activities</li> <li>• Mine safety</li> <li>• Effect of mining on environment</li> </ul> <p>2.5 Food Resources:</p> <ul style="list-style-type: none"> <li>• Food for all</li> <li>• Effects of modern agriculture</li> <li>• World food problem</li> </ul>	04	10
<p><b>Topic 3. Ecosystems</b></p> <ul style="list-style-type: none"> <li>• Concept of Ecosystem</li> <li>• Structure and functions of ecosystem</li> <li>• Energy flow in ecosystem</li> <li>• Major ecosystems in the world</li> </ul>	01	04
<p><b>Topic 4. Biodiversity and Its Conservation</b></p> <ul style="list-style-type: none"> <li>• Definition of Biodiversity</li> <li>• Levels of biodiversity</li> </ul>	02	06

<ul style="list-style-type: none"> <li>• Value of biodiversity</li> <li>• Threats to biodiversity</li> <li>• Conservation of biodiversity</li> </ul>		
<b>Topic 5. Environmental Pollution</b> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Air pollution: Definition, Classification, sources, effects, prevention</li> <li>• Water Pollution: Definition, Classification, sources, effects, prevention</li> <li>• Soil Pollution: Definition, sources, effects, prevention</li> <li>• Noise Pollution: Definition, sources, effects, prevention</li> </ul>	03	08
<b>Topic 6. Social Issues and Environment</b> <ul style="list-style-type: none"> <li>• Concept of development, sustainable development</li> <li>• Water conservation, Watershed management, Rain water harvesting: Definition, Methods and Benefits</li> <li>• Climate Change, Global warming, Acid rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust: Basic concepts and their effect on climate</li> <li>• Concept of Carbon Credits and its advantages</li> </ul>	03	10
<b>Topic 7. Environmental Protection</b> Brief description of the following acts and their provisions: <ul style="list-style-type: none"> <li>• Environmental Protection Act</li> <li>• Air (Prevention and Control of Pollution) Act</li> <li>• Water (Prevention and Control of Pollution) Act</li> <li>• Wildlife Protection Act</li> <li>• Forest Conservation Act</li> </ul> Population Growth: Aspects, importance and effect on environment <ul style="list-style-type: none"> <li>• Human Health and Human Rights</li> </ul>	02	08
<b>Total</b>	<b>16</b>	<b>50</b>

**Practical:****Skills to be developed:****Intellectual Skills:**

1. Collection of information, data
2. Analysis of data
3. Report writing

**Motor Skills:**

1. Presentation Skills
2. Use of multi media

**List of Projects:**

**Note:** Any one project of the following:

1. Visit to a local area to document environmental assets such as river / forest / grassland / hill / mountain
2. Visit to a local polluted site: Urban/Rural/Industrial/Agricultural
3. Study of common plants, insects, birds

4. Study of simple ecosystems of ponds, river, hill slopes etc

**Prepare a project report on the findings of the visit illustrating environment related facts, analysis and conclusion. Also suggest remedies to improve environment.**

**Learning Resources:**

**Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
01	Anindita Basak	Environmental Studies	Pearson Education
02	R. Rajgopalan	Environmental Studies from Crises to Cure	Oxford University Press
03	Dr. R. J. Ranjit Daniels, Dr. Jagdish Krishnaswamy	Environmental Studies	Wiley India

**Course Name : Diploma in Automobile Engineering**

**Course Code : AE**

**Semester : Fourth**

**Subject Title : Automobile Manufacturing Processes**

**Subject Code : 17403**

**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:**

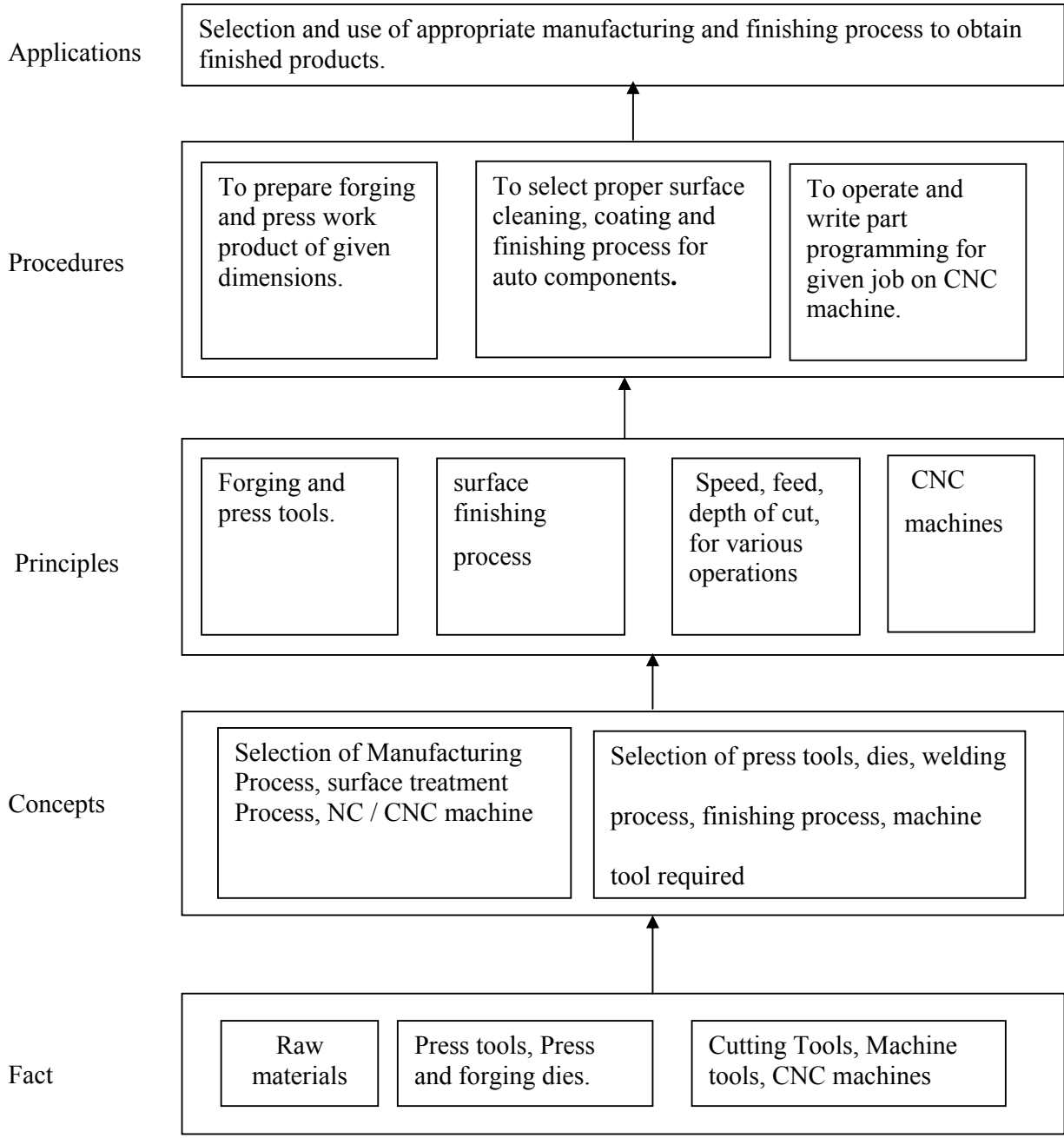
Automobile manufacturing processes is a core technological subject. With advent of technology there are many advances in manufacturing processes and equipments. The knowledge of these advances is essential for a diploma student engaged in manufacturing organizations. Students should be able to write and apply CNC programs in manufacturing industry.

**General Objectives:**

Student will be able to,

- Know the forging process and it's use in manufacturing automobile parts.
- Know the different press tools and their operations.
- Understand different welding processes used in industry.
- Selection and applications of different surface cleaning and coating processes
- Know the different methods of surface finishing.
- Know about sub-systems of CNC machines and write CNC programs.

**Learning Structure:**





**Theory**

<b>Topic and Contents</b>	<b>Hours</b>	<b>Marks</b>
<b>1: Forging</b> <span style="float: right;"><b>16 Marks</b></span> Specific Objectives: ➤ Understand forging processes and their applications Contents: 1.1 Introduction: <span style="float: right;"><b>08 Marks</b></span> <ul style="list-style-type: none"> <li>• Forgeable materials and forgeability</li> <li>• Classification of forging processes</li> <li>• Advantages and limitations of forging processes</li> </ul> 1.2 Forging sequences for Auto components- <span style="float: right;"><b>08 Marks</b></span> Connecting rods, Crankshafts, Camshafts and Spanners	06	16
<b>2: Press and press work</b> <span style="float: right;"><b>24 Marks</b></span> Specific Objectives: ➤ Know the press operations and their applications Contents: 2.1 Introduction <span style="float: right;"><b>08 Marks</b></span> <ul style="list-style-type: none"> <li>• Materials used in press work for automobile applications.</li> <li>• Classifications of presses and terminology used in presses</li> <li>• Major parts of Fly press</li> </ul> 2.2 Press tools <span style="float: right;"><b>12 Marks</b></span> <ul style="list-style-type: none"> <li>• Parts of standard die set</li> <li>• Die accessories- Pilots, Stops, Strippers, Pressure pads and Knock outs</li> <li>• Types and construction of dies—Simple, progressive, compound and combination die</li> </ul> 2.3 Press operations- <span style="float: right;"><b>04 Marks</b></span> Blanking, piercing, bending, drawing.	12	24
<b>3: Welding processes</b> <span style="float: right;"><b>16 Marks</b></span> Specific Objectives: ➤ Know various welding operations and their applications Contents: 3.1 Introduction <span style="float: right;"><b>04 Marks</b></span> <ul style="list-style-type: none"> <li>• Classification and selection of welding process.</li> <li>• Working principle of Gas welding and types of flames.</li> </ul> 3.2 Arc welding process <span style="float: right;"><b>08 Marks</b></span> <ul style="list-style-type: none"> <li>• Metal arc, TIG and MIG</li> </ul> 3.3 Resistance welding, Brazing and soldering <span style="float: right;"><b>04 Marks</b></span>	08	16
<b>4: Surface treatment and finishing processes</b> <span style="float: right;"><b>10 Marks</b></span> Specific Objectives: ➤ Know various surface cleaning, coating and finishing operations. Contents: 4.1 Surface cleaning and coating processes <span style="float: right;"><b>06 Marks</b></span> <ul style="list-style-type: none"> <li>• Surface cleaning processes- acid, alkaline, electrolytic cleaning, blasting and tumbling</li> <li>• Metallic surface coating- Electroplating, Galvanizing and metal spraying</li> </ul> 4.2 Surface finishing processes <span style="float: right;"><b>04 Marks</b></span>	04	10

<ul style="list-style-type: none"> <li>Lapping, honing, super finishing, buffing, burnishing and their applications, advantages and limitations.</li> </ul>		
<b>5: Introduction to CNC machines</b> <span style="float: right;"><b>16 Marks</b></span> Specific Objectives: ➤ Know the basic components of CNC machines and tools.  Contents: <ul style="list-style-type: none"> <li>NC and CNC Machines.</li> <li>Difference between conventional machines and CNCs.</li> <li>Working principle of CNC machines.</li> <li>Classification of CNC machines.</li> <li>Advantages and disadvantages of CNC machines.</li> <li>Type of tools used on turning center and VMC.</li> <li>Absolute and Incremental Co-ordinate system.</li> </ul>	08	16
<b>6. CNC Part programming</b> <span style="float: right;"><b>18 Marks</b></span> Specific Objectives: ➤ Understand and write CNC part programming Content : <ul style="list-style-type: none"> <li>Axes configuration- X, Y and Z axes.</li> <li>Procedure for developing the Part program</li> <li>ISO Codes used in programming</li> <li>Simple Part programming as per ISO codes on CNC and VMC for operations like turning, drilling and Milling.</li> </ul>	10	18
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

- Understand the different types of press and welding components.
- Know the different types of programming codes

**Motor Skills:**

- To prepare given job on milling machine.
- To use press machine to produce various auto components
- To prepare job by welding process
- To produce a job on CNC turning center

**List of Practicals:**

- One job involving different milling machine operations such as key way cutting, gear cutting by indexing in a batch of 2 students.
- One press work job involving operations like blanking, piercing and drawing. (Job should be selected from market utility).
- One resistance welding job to show the working principle of resistance welding. Calculate current and time required for completion of a resistance welding job.
- One simple part programming job on CNC machine. One job on CNC lathe having plain turning, taper turning, step turning, threading, boring and grooving (Batch of 2 students).

OR

One job on CNC milling having following operations – face milling, slotting, contour machining (Batch of 2 students)

- Industrial visit shall be arranged to demonstrate different Milling machines, grinding machines, CNC machines, forging operations, press operations, Surface treatment and surface finishing processes. Write a report.

**Note: Different machine tools and operations may be shown during industrial visits arranged under Professional Practices -IV**

**List of Assignments:**

- ISO codes for turning and machining center used in CNC programming.
- Prepare Process sheet for forging operations of a simple automobile component.
- Prepare Process sheet for press working operation using compound or progressive die.

**Learning Resources:**

**1. Books:**

Sr No.	Author	Title	Publication
1.	S. K. Hajra Choudhury. A. K. Hajra Choudhury. Nirjhar Roy	Elements of Workshop Technology. Vol. - I and II	Media Promoters and Publishers Pvt. Ltd. Mumbai.
2.	H. S. Bawa	Workshop Technology Vol. - I and II.	Tata McGraw-Hill Publishing Co. Ltd. New Delhi.
3.	R. K. Jain	Production Technology	Khanna Publishers. Delhi.
4.	P.N.Rao	CAD/CAM Principles and applications	Tata McGraw-Hill Publishing Co. Ltd. New Delhi.
5.	Aditan Pabla	CNC machines programming and applications	New Age International Publication
6.	Serope Kalpakjian Steven R. Schmid	Manufacturing Engineering and Technology	Pearson
7	N.K. Chougule	CAD/CAM/CAE	Sciotech

**1. CDs, PPTs Etc.:**

Electronics Trades and Technology Development Corporation (A Govt. Of India undertaking), Akbar Hotel Anex, Chankyapuri, New Delhi-110 021.

Learning Materials: Transparencies, CBT packages developed by N.I.T.T.E.R. Bhopal.

**2. Websites:**

www.npkauto.com  
www.youtube.com

**Course Name : Diploma in Automobile Engineering**

**Course Code : AE**

**Semester : Fourth**

**Subject Title : Heat Power Engineering**

**Subject Code : 17407**

**Teaching and Examination Scheme**

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

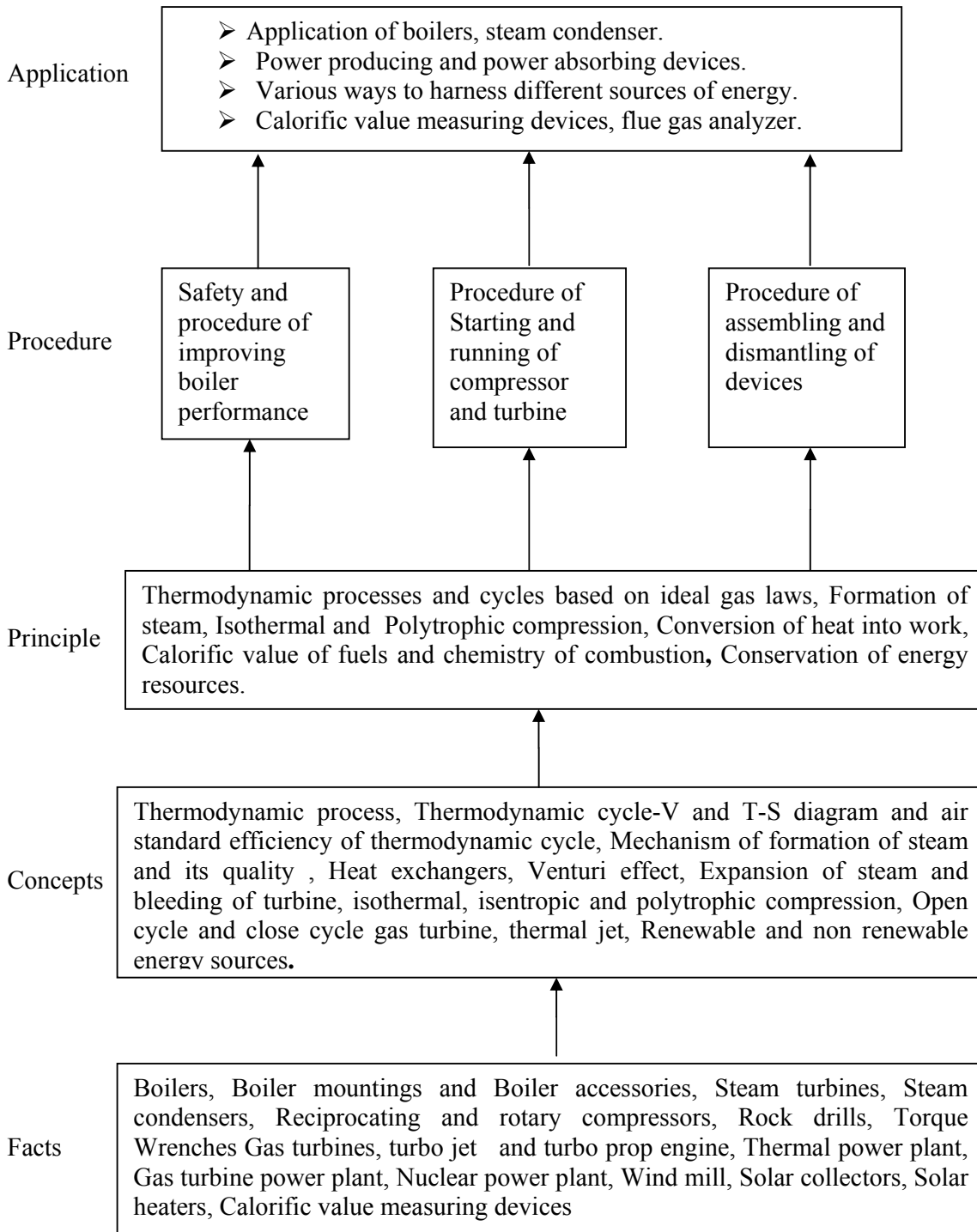
Heat energy is the basis for most of the power producing and power absorbing devices. In order to understand the principles and working of these devices it is essential to understand the basic laws and concepts of thermodynamic processes and gas cycles, properties of steam, generation of steam with modern boilers, steam condensers and turbines. As modern diesel engine vehicles are turbocharged. Students should also understand the working principles and constructions of air compressors gas turbines and jet engines. Due to energy crunch of petroleum products worldwide hunt for alternative energy sources is being done for the last three decades. Hence students should also have comparative brief idea about various conventional energy sources, calorific values, carbon value and evaporative power of fuels and exploration of various alternative energy sources. Student should have capability to know the necessary parameters affecting efficiency of heat absorption, rejection or conversion devices into work.

**Objectives:**

Students will be able to:

- Correlate the theoretical knowledge with practical aspects of systems of work producing and work absorbing devices like boilers, condensers, steam turbines, air compressors, gas turbines etc.
- Describe various sources of energy and ways to harness it.
- Understand the chemistry of fuel and Estimate calorific value, mass of air required for complete combustion of fuels.
- Identify and locate various parts of equipments, use of instruments, tools for assembly and dismantling of various devices.
- Observe the working of devices with change in parameters

**Learning Structure:**



**Theory:**

Topic and Content	Hours	Marks
<p><b>1. Fundamentals of thermodynamics. 18 marks</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Understand the concepts of thermodynamic processes and air cycles.</li> <li>➤ Know applications of thermodynamic principles and processes in various heat engines and power absorbing devices.</li> </ul> <p>Contents:</p> <p>1.1 Study of thermodynamic processes for ideal gases</p> <ul style="list-style-type: none"> <li>• Represent Isobaric, Isochoric, Isothermal, Adiabatic and polytropic processes on P-V and T-S diagram, formulae of work done, change in internal energy and change in enthalpy.</li> <li>• Relation between P,V and T (Derivations only for adiabatic process, No mathematical calculations for any process)</li> </ul> <p>1.2 Air cycles:</p> <ul style="list-style-type: none"> <li>• P-V and T-S diagram and equations for air standard efficiency of Carnot, Otto, Diesel and Dual combustion cycle.</li> </ul> <p>1.3 Fundamental of Heat transfer</p> <ul style="list-style-type: none"> <li>• Modes of heat transfer – conduction, convection and radiation</li> <li>• Application of heat transfer in automobiles</li> </ul>	09	18
<p><b>2. Properties of Steam and Steam Power 18 Marks</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know the process of formation of steam and efficient use of heat energy stored in the steam into mechanical work</li> </ul> <p>Content:</p> <p>2.1 Formation of steam, various phases like wet steam, dry saturated steam, superheated steam. <b>4 Marks</b></p> <ul style="list-style-type: none"> <li>• Dryness fraction, degree of superheat, sensible heat, Latent heat, calculation of enthalpy of wet, dry saturated and superheated steam using Steam table.</li> </ul> <p>2.2 Steam boilers- <b>8 Marks</b></p> <p>construction and working of i) Three pass packaged type boiler ii) La Mont Boiler</p> <p>2.3 Steam condenser: <b>6 Marks</b></p> <ul style="list-style-type: none"> <li>• Function, locations in steam power plant.</li> <li>• Construction and working of two pass down flow Surface condenser.</li> <li>• Condenser efficiency and sources of air leakage in condenser</li> </ul>	09	18
<p><b>3. Air Compressors 18 Marks</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know the working of reciprocating and rotary air compressor and it's application.</li> <li>➤ Understand working of different pneumatic tools.</li> </ul> <p>Content:</p> <p>3.1 Classification of air compressor - Construction and working of single stage and two stage reciprocating air compressors with P-V. diagram. Necessity of multi-staging and inter cooling. Construction and working of rotary compressors i) Centrifugal compressor ii) Axial flow compressor iii) Screw compressor, Comparison of various compressors</p> <p>3.2 Air compressor terminology like i) Free air delivered, ii) Capacity of</p>	08	18

Compressor, iii) Piston displacement, iv) I. P., v) B. P., vi) Volumetric efficiency, vii) Isothermal efficiency, viii) Overall Isothermal or Compressor efficiency. (Only definitions), Factors affecting volumetric Efficiency of reciprocating air compressors. 3.3 Applications of compressed air: construction and working of i) Rock drill, ii) pneumatic torque wrench		
<b>4. Gas Turbines</b> <b>14 Marks</b> Specific Objectives: ➤ Know the working of gas turbine and its application in aviation industries. Content: 4.1 Brayton cycle - P.V. diagram and thermal efficiency. <b>4 Marks</b> • Classification of gas turbines. 4.2 Construction and working of gas turbines i) open cycle, ii) closed cycle gas Turbines, P.V. and T.S diagrams. <b>10 Marks</b> • Turbojet and turboprop engine. (no numerical)	06	14
<b>5. Sources of Energy and Power plants</b> <b>16 Marks</b> Specific Objectives: ➤ Know various sources of conventional and non-conventional energy with their applications. 5.1 Classification of various conventional and non-conventional sources of energy. Construction and working of power plants based on conventional energy sources like : a) Thermal power plant b) Gas turbine power plant c) Nuclear power plant - Pressurized water reactor. • Parameters for the site selection of conventional power plants. 5.2 Power plants based on non-conventional energy sources. i) Solar, ii) Biomass, iii) Wind energy • Concepts of Geothermal and tidal power plant.	08	16
<b>6. Fuels and Combustion</b> <b>16 Marks</b> Specific Objectives: ➤ Know the comparative information of properties of various fuels. ➤ Know the chemistry of combustion of fuels. ➤ Calculate H.C.V./L.C.V of fuels and requirement of theoretical or minimum air required for combustion of fuel. Content: 6.1 Types of fuels – <b>4 Marks</b> Definition, classification, properties, Calorific value of fuels. • Ultimate analysis and proximate analysis of solid fuels. • Liquid fuels- Comparative information about composition, specific gravity and gross calorific values of liquid fuel. • Gaseous fuels- natural, LPG, CNG, and other artificially prepared gaseous fuels. 6.2 Higher and lower Calorific values of fuel and its estimation, carbon value, evaporative power of fuel. Dulong's formula, construction and working of Bomb calorimeter. <b>8 Marks</b> 6.3 Combustion of fuels – combustion chemistry of carbon, hydrogen and methane. Mass of air required for complete combustion of fuel, excess air. <b>4 Marks</b>	08	16
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual skills:**

1. Describe the locations of components.
2. Analyse the functioning of systems and respective components.
3. Describe the direction flow of fluids and work
4. Analyse the parameters affecting safety and efficiency of devices.

**Motor Skills:**

1. Proper use of tools.
2. Practice of safe working procedures.
3. Variations in parameters affecting efficiency.

**List of Practicals:**

- 1) Visit to any industry where boiler is installed with reference to observations of locations, constructions and working of boiler mountings like safety valve and Bourdon's pressure gauge and boiler accessories like a) economizer b) super-heater.  
  
(The same should also be explained on cut- section and table model in laboratory)
- 2) Visit to cogeneration plant of sugar factory or any other thermal power plant with reference to observation of components, path of steam, minimum and maximum r.p.m., governing, bleeding and maintenance schedule of steam turbine.
- 3) Study the provisions of Indian boiler act with reference to duties of boiler inspector, chief inspector, annual registration process and accident.
- 4) Dismantling and assembling of one reciprocating and one rotary compressor.
- 5) Study of system components of gas turbines used in turbocharger with reference to direction of flow of air and flue gas, shape of vanes, blades also describe maintenance schedule of gas turbine.
- 6) Study any solar water heater and calculate it's efficiency.
- 7) Determination of calorific value of solid or liquid fuel using Bomb calorimeter.
- 8) Visit a wind mill to study the various features and prepare report containing specification, materials, operating speed range, wind speed data, locking mechanism, protective coatings and efficiency.

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

Sr. No.	Author	Title	Publisher
1	R. S. Khurmi and J. K. Gupta	A Text book of Thermal Engineering	S. Chand and Co. Ltd.
2	Patel, Karamchandani	Elements of Heat Engines (Vol. I, II and III)	Acharya Book Depot.



3	A course in Thermal Engineering	S. Domkundwar, Dr C.P. Kothandaramanand A.V. DOMkundwar	Dhanpat Rai and Co.(P)Ltd, New Delhi
4	Engineering Thermodynamics	Jones and Dugan	Prentice hall of India Publication.
5	Thermodynamics	Yunus Cegeland Mike Boles	Tata McGraw Hill Publication
6	Engineering Thermodynamics Work and Heat Transfer	Gordon Rogers Yon Mayhew	Pearson
7	Govt. of India	Indian Boiler Act - 1923	--

## 2. Websites

[www.howstuffworks.com](http://www.howstuffworks.com)

[www.wikipedia.com](http://www.wikipedia.com)

[www.watertubeboiler.org](http://www.watertubeboiler.org)

[www.scince.uwaterloo.ca](http://www.scince.uwaterloo.ca)

**Course Name : Diploma in Automobile Engineering**

**Course Code : AE**

**Semester : Fourth**

**Subject Title : Automobile Engines**

**Subject Code : 17408**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	04	03	100	50#	--	25@	175

**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:**

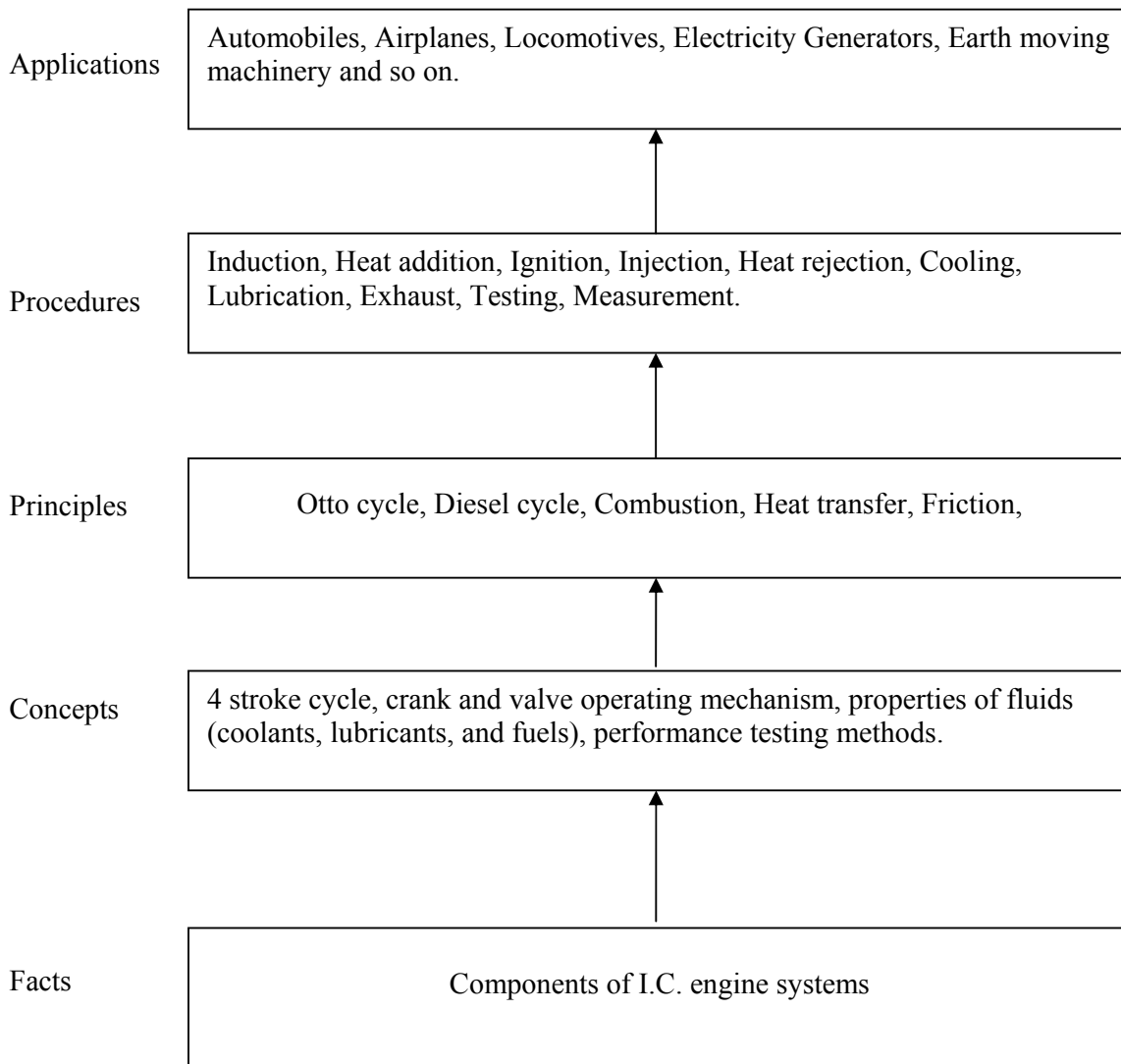
This is a core technology subject. I C engines are required to run the vehicles. The basic principles of Thermodynamics are applied in I C engine. This subject forms the basis for the Advanced Automobile Engine and vehicle maintenance. Knowledge of various engine systems will be helpful in finding and evaluating engine maintenance problems.

**General Objectives:**

Students will be able to,

- Understand working principles, comparison and applications of I C engine.
- Know constructional details of different types of engine.
- Draw layout and understand construction and working of various systems required in engine.
- Perform tests on I.C. engine and estimate performance parameters.

**Learning Structure:**



**Theory:**

Topics and Contents	Hours	Marks
<p><b>01. Fundamentals of I.C. Engine</b> <span style="float: right;"><b>16 marks</b></span></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Understand working principle of four and two stroke cycle engines.</li> <li>➤ Write nomenclature of engine.</li> <li>➤ Compare petrol and diesel engines, four stroke and two stroke engines.</li> <li>➤ Classify I.C. engines and write their specifications.</li> </ul> <p><b>Content</b></p> <p>1.1 Introduction <span style="float: right;">4 Marks</span></p> <ul style="list-style-type: none"> <li>• Definition of I C engine.</li> <li>• Engine nomenclature.</li> </ul> <p>1.2 The working principle of Engine <span style="float: right;">6 Marks</span></p> <ul style="list-style-type: none"> <li>• Four-Stroke Spark Ignition Engine.</li> <li>• Four-Stroke Compression Ignition Engine.</li> <li>• Comparison of Four-Stroke SI and CI Engine.</li> <li>• Two-Stroke Engines</li> <li>• Scavenging.</li> <li>• Comparison of Four-Stroke and Two-Stroke Engine.</li> </ul> <p>1.3 Classification, Specifications and applications <span style="float: right;">6 Marks</span></p> <ul style="list-style-type: none"> <li>• Classification of engine on the basis of: Cycle of operation, Fuel, Method of Charging, Ignition, Cooling, Cylinder arrangement, camshaft layout.</li> <li>• Merits and Demerits of Vertical and horizontal engines.</li> <li>• Engine Specifications - Two Wheelers, Light Motor Vehicle, Medium Motor Vehicle and Heavy Motor Vehicle.</li> <li>• Applications of I C Engines.</li> </ul>	08	16
<p><b>02. Construction of I. C. Engine</b> <span style="float: right;"><b>20 Marks</b></span></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Describe function, Construction and material of engine components.</li> <li>➤ Understand Types of drives required to operate, draw and describe various mechanisms.</li> <li>➤ Understand and draw Valve and port timing diagrams.</li> </ul> <p><b>Content</b></p> <p>2.1 Function, construction , materials and manufacturing methods of Engine components <span style="float: right;">16 Marks</span></p> <ul style="list-style-type: none"> <li>• Cylinder block, Cylinder liners – Dry and Wet, Cylinder head, Inlet and Exhaust manifold, Tappet cover, Timing cover, Crank case. Oil Sump.</li> <li>• Crank Mechanism: Piston and piston rings, Piston pin, Connecting rod, Crank Shaft, Cam shaft, Flywheel, Bearings, Oil seals, Gaskets. (Only the Name of commonly used Manufacturing Method is expected)</li> <li>• Valve and Valve Operating Mechanisms: Overhead Valve and Overhead Cam arrangements.</li> <li>• Valve Cooling.</li> </ul> <p>2.2 Camshaft Drives and Valve Timing <span style="float: right;">4 Marks</span></p> <ul style="list-style-type: none"> <li>• Camshaft drives: Timing Gears, Chain and Belt drive. Relation between speed of camshaft and crank Shaft.</li> <li>• Valve timing Diagram, Port timing Diagram.</li> </ul>	10	20

<p><b>03. Fuel and Air Feed System</b> <span style="float: right;"><b>16 Marks</b></span></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Draw layout of fuel and air feed systems.</li> <li>➤ Understand, describe, and compare the construction and working of components involved in the systems.</li> </ul> <p><b>Content</b></p> <p>3.1 Petrol fuel supply system. <span style="float: right;">8 Marks</span></p> <ul style="list-style-type: none"> <li>• Conventional Petrol Engine: Gravity feed, Pump feed (Layout, Function of Components and location).</li> <li>• Construction and working of components: Fuel Tank, Fuel Filter, S. U. Electrical Fuel Pump, Air cleaners – dry type and Oil wetted types.</li> <li>• Working Principle of Simple Carburettor, Air Fuel ratio requirements, Circuits in Two-wheeler carburettor and Solex carburettor.</li> </ul> <p>3.2 Diesel fuel supply system <span style="float: right;">8 Marks</span></p> <ul style="list-style-type: none"> <li>• Diesel Engine: Need and requirements of Fuel Injection Systems.</li> <li>• Layout of Fuel Injection systems – Individual pump, Unit injector system, Distributor system and Common rail system.</li> <li>• Fuel Injector and types of nozzles.</li> <li>• Fuel metering in Fuel Injection Pump ( Inline pump and Distributor pump )</li> <li>• Working principle of Mechanical Governor in Fuel Injection Pump.</li> </ul>	08	16
<p><b>04. Ignition and Exhaust system</b> <span style="float: right;"><b>8 Marks</b></span></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Understand ignition systems.</li> <li>➤ Understand firing order of the engine.</li> <li>➤ Compare various types of mufflers</li> </ul> <p><b>Content</b></p> <p>4.1 Introduction to Ignition System <span style="float: right;">4 Marks</span></p> <ul style="list-style-type: none"> <li>• Requirements of ignition system.</li> <li>• Magneto and Battery Ignition systems (Working only).</li> <li>• Firing order used in 3,4 and 6 cylinder engines</li> </ul> <p>4.2 Types of Exhaust system <span style="float: right;">4 Marks</span></p> <ul style="list-style-type: none"> <li>• Function of Exhaust manifold.</li> <li>• Construction, Working and types of silencer / Mufflers.</li> </ul>	04	08
<p><b>05. Cooling and Lubrication systems</b> <span style="float: right;"><b>20 Marks</b></span></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Identify components and types of cooling and lubrication systems</li> <li>➤ Compare Cooling and Lubrication systems.</li> </ul> <p><b>Content:</b></p> <p>5.1 Engine cooling system <span style="float: right;">4 Marks</span></p> <ul style="list-style-type: none"> <li>• Need of cooling system.</li> <li>• Limitations of cooling system.</li> <li>• Types: Air, Water/ Liquid cooling system (Layout and Function of Components)</li> <li>• Properties of coolants and coolant additives</li> </ul> <p>5.2 Construction and working of cooling system <span style="float: right;">6 Marks</span></p> <ul style="list-style-type: none"> <li>• Construction and working of: Thermostat valve, Water expansion tank, Temperature Indicators, Pressure cap, Water pump, Fan and fan belt.</li> <li>• Electrically driven Fan circuit.</li> </ul>	10	20

<ul style="list-style-type: none"> <li>Radiator: Construction and type of radiator cores.</li> </ul> 5.3 Introduction to Lubrication system <span style="float: right;">4 Marks</span> <ul style="list-style-type: none"> <li>Need of lubrication system.</li> <li>Properties of lubricating oil, additives of lubricating oil.</li> <li>Parts to be lubricated.</li> </ul> 5.4 Types of Lubrication system <span style="float: right;">6 Marks</span> <ul style="list-style-type: none"> <li>Types of lubrication system: Splash, Pressure – wet sump and dry sump (Layout of lubrication system)</li> <li>Components: Oil filters, Pump and its drive, pressure regulators, oil pressure gauge.</li> <li>Positive crank case ventilation</li> <li>Classification of Lubricating Oils on the basis of Viscosity (SAE) and Load (API) Severity rating.</li> </ul>		
<b>06. Performance of Engine</b> <span style="float: right;"><b>20 Marks</b></span> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ Understand performance parameters, draw engine characteristic graphs.</li> <li>➤ Perform Engine tests and measure different parameters and analyze the results.</li> </ul> <b>Content:</b> 6.1 Performance parameters. <span style="float: right;">04 Marks</span> <ul style="list-style-type: none"> <li>Definitions: Indicated Power, Brake Power and Frictional Power, Efficiencies - Air standard, Mechanical, Brake Thermal, Indicated Thermal, Volumetric and Relative.</li> </ul> 6.2 Dynamometers and engine testing: <span style="float: right;">16 Marks</span> <ul style="list-style-type: none"> <li>Working Principle and types of Dyanmometers: Rope brake, Hydraulic and Eddy current.</li> <li>Engine Testing: Morse Test, Willian’s line Method for finding Frictional Power.</li> <li>Heat balance sheet and Method of calculating Volumetric Efficiency and Fuel Consumption.( Simple Numerical problems)</li> </ul>	08	20
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:****Skills to be developed:****Intellectual skill:**

- Understand working principle of S.I. / C.I. engine
- Select special tools used for engine disassembly / assembly.
- Identify engine components.
- Identify components of the engine systems.
- Interpret results from engine power observations and calculations.

**Motor Skills:**

- Sketch engine components and engine system components.
- Measure certain parameters with the help of - dynamometer, air box, fuel measuring burette, exhaust gas calorimeter, measuring tools.

**Practicals:**

1. Use Special Tools In Dismantling And Assembling By Identifying Tools, Demonstrating and Arranging The Practice Of Same.
2. Operate Cut Section Engine Model To Understand Engine Nomenclature and Operate Engine.
3. Identify and Observe Location Of Various Engine Components.
4. Trace Induction System and Fuel Supply System Curve to Understand the Characteristics.
5. Dismantle Ignition System and Distributor Assembly, To Understand The Functions.
6. Dismantle Cooling System, Identify Components and Their Functions.
7. Dismantle Lubrication System, Identify Components. Draw Layout.
8. Prepare Heat Balance Sheet And Plot Performance Characteristics Curve of An Engine After Trial.
9. Conduct Morse Test On Multicylinder Engine & Calculate Frictional Power & Mechanical Efficiency.
10. Dismantle & Assemble An Engine.

**Notes:**

1. **Practicals may be performed in a group of 4 to 6 students.**
2. **Engine testing practicals may be performed by the batch.**

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

Sr. No.	Author	Title	Publisher / Edition
1	Dr. Kirpal Singh	Automobile Engg. Vol.-2	Standard Publishers
2	Anil Chhikara	Automobile Engineering Vol.1	Satya Prakashan, New Delhi
3	R.B. Gupta	Automobile Engineering	Satya Prakashan
4	K.K. Ramlingam	Automobile Engineering	Scitech Publications
5	John B. Heywood	Internal Combustion Engine Fundamentals	McGraw-Hill International Edition
6	Newton and Steeds	Internal Combustion Engine	--

**2. Websites:**

[www.npkauto.com](http://www.npkauto.com)

[www.howstuffworks.com](http://www.howstuffworks.com)

[www.youtube.com](http://www.youtube.com) for animations and videos of various engine system operations.

**Course Name : Diploma in Automobile Engineering**

**Course Code : AE**

**Semester : Fourth**

**Subject Title : Automobile Systems and Body Engineering**

**Subject Code : 17409**

**Teaching and Examination Scheme:**

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

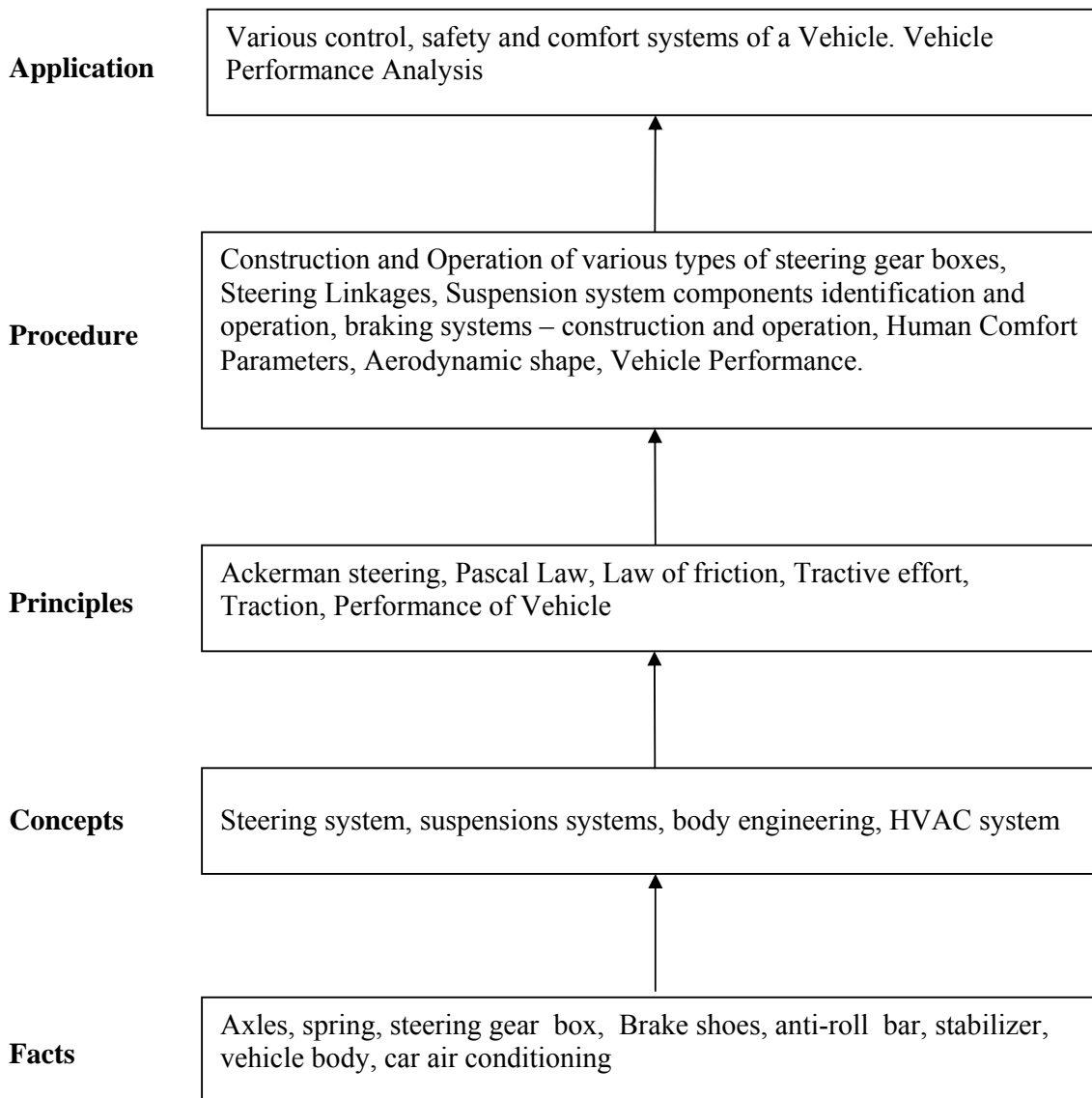
This subject is Core Technology subject for Automobile Engineering course. This subject is part of Automobile systems concerning control of vehicles. Knowledge of this subject is required in the subjects like Automobile Component Design, Vehicle maintenance, vehicle testing. Conceptual knowledge of this subject is useful for understanding and improving the performance of Automobile system.

**General Objectives:**

Students will be able to:

1. Understand construction, working and functions of Automobile Systems.
2. Understand construction, working and functions of Automobile control systems such as steering, braking and suspension.
3. Compare the developments in body engineering, control systems and safety equipment



**Learning Structure:**

**Theory Content:**

<b>Topic and Contents</b>	<b>Hours</b>	<b>Marks</b>
<b>1: Front Axle and Steering</b> <span style="float: right;"><b>22 Marks</b></span> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ Know various types of steering linkages.</li> <li>➤ Understand working of different steering gear boxes.</li> <li>➤ Know steering geometry.</li> <li>➤ Understand concept of power steering.</li> </ul> <b>Content:</b> <p>1.1 Front Axle: <span style="float: right;">8 Marks</span></p> <ul style="list-style-type: none"> <li>• Types of front axle - Dead axle, live axle.</li> <li>• Type of stub axle arrangements- Elliot, reverse Elliot, Lamoine, reverse Lamoine.</li> <li>• Front wheel assembly.</li> </ul> <p>1.2 Steering system. : <span style="float: right;">14 Marks</span></p> <ul style="list-style-type: none"> <li>• Steering linkages.</li> <li>• Steering geometry and its effects – Caster, camber, king pin inclination, toe in– toe out, Correct Steering angle. Understeering and oversteering, Turning radius.</li> <li>• Construction, working and application of Steering gear box - rack and pinion type, recirculating ball type, and worm and rollertype.</li> <li>• Ackerman Principle and linkage.</li> <li>• Power assisted steering and its types (Hydraulic and electrical)</li> </ul>	12	22
<b>2: Brakes</b> <span style="float: right;"><b>20 Marks</b></span> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ Know various types of braking systems.</li> <li>➤ Understand construction and working of different braking system components.</li> <li>➤ Know latest developments in braking system.</li> </ul> <b>Content:</b> <p>2.1 Introduction <span style="float: right;">8 Marks</span></p> <ul style="list-style-type: none"> <li>• Function and necessity of brakes.</li> <li>• Classification of brakes and braking systems.</li> <li>• Construction and working of -disc brake and drum brake</li> <li>• Friction materials used for brake shoes and pads. Characteristics of friction material- brake fade, coefficient of friction, dry friction and wet friction</li> </ul> <p>2.2 Braking systems <span style="float: right;">12 Marks</span></p> <ul style="list-style-type: none"> <li>• Construction and working of - Mechanical braking system, Hydraulic Braking system, Air braking system, Hydraulic operated air braking system and vacuum assisted braking system.</li> <li>• Concept and working of antilock braking system.</li> <li>• Parking brake</li> <li>• Properties of brake fluids and their specifications.</li> </ul>	10	20
<b>3: Suspension Systems</b> <span style="float: right;"><b>18 Marks</b></span> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ Identify and describe various components of suspension systems.</li> </ul>	10	18

<p>➤ Know latest developments in suspension systems.</p> <p><b>Content:</b></p> <p>3.1 suspension systems <span style="float: right;">10 Marks</span></p> <ul style="list-style-type: none"> <li>• Rigid and independent Suspension.</li> <li>• Types of Independent suspension system-McPherson strut, wishbone type.</li> <li>• Semi-elliptical Leaf spring, coil spring , torsion bar arrangement,</li> <li>• Construction and working of Air Suspension System.</li> </ul> <p>3.2 Construction and working of- <span style="float: right;">8 Marks</span></p> <ul style="list-style-type: none"> <li>• Shock absorbers -Telescopic and Gas filled</li> <li>• Anti roll bar or stabilizer bar.</li> </ul>		
<p><b>4: Body Engineering and Safety Devices.</b> <span style="float: right;">16 Marks</span></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know various types of materials used for automobile body.</li> <li>➤ Understand protective treatment of automobile body.</li> <li>➤ Know latest developments in safety devices.</li> </ul> <p>Content:</p> <ul style="list-style-type: none"> <li>• Types of bodies and materials used in body construction</li> <li>• Protective and anticorrosive treatments, painting and repainting procedure.</li> <li>• Safety devices –air bags, exhaust brake, emergency brake, central locking, Collapsible steering.</li> </ul>	06	16
<p><b>5: Car Heating Ventilation and Air Conditioning System (HVAC)</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Understand the basic principles of HVAC system.</li> <li>➤ Know the comfort conditions of the occupants.</li> </ul> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Fundamentals of Refrigeration and air conditioning.</li> <li>• Description of vapour compression cycle with components in the circuit.</li> <li>• Layout and operation of HVAC.</li> <li>• Type of refrigerants used in car air conditioning and their properties.</li> <li>• Human comfort conditions.</li> <li>• Temperature control system, humidity control.</li> </ul>	06	16
<p><b>6: Vehicle Performance :</b> <span style="float: right;"><b>08 Marks</b></span></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know and describe various resistances experienced by a vehicle.</li> <li>➤ Understand the effects of resistances on a vehicle.</li> </ul> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Resistance faced by the vehicle- Air resistance , rolling resistance, gradient resistance</li> <li>• Definitions- traction, tractive efforts, drawbar pull, gradeability and acceleration, pitching, bouncing, rolling, sway and yaw.</li> <li>• Stability of vehicle on turn and slopes (No mathematical treatment).</li> <li>• Concept of Streamline shape of a vehicle body</li> </ul>	04	08
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

Student will be able to.

1. Identify parts like front axle, steering, brakes, suspension system.
2. Classify the system according to their application.
3. Select proper tools and their range.
4. Understand the construction and working of the system under consideration.

**Motor Skills:**

Student will be able to.

1. Sketch the different systems and their components.
2. Handle tools, equipment and instruments.
3. Dismantle and assemble various system assemblies.

**List of Practicals:**

01	Know your Automobile Systems laboratory through, listing the systems, models, and charts in laboratory with their purpose. <ul style="list-style-type: none"> <li>• Listing the tools used in dismantling and assembly of various Automobile Systems.</li> </ul>
02	Observe the steering linkages, draw its layout. Dismantle the steering gear box, identify its type, sketch its components and assemble it.
03	Observe and sketch different types of Front Axles.
04	<ul style="list-style-type: none"> <li>• Observe and draw the layout of hydraulic braking system. Dismantle master cylinder, wheel cylinder and remove brake drum, identify and sketch the components and assemble it.</li> </ul> Observe and draw the layout of hydraulically operated air/vacuum assisted braking system
05	<ul style="list-style-type: none"> <li>• Observe and sketch the construction of Mc pherson and wishbone type suspension with labels.</li> <li>• Dismantle semi elliptical leaf spring, sketch its components with labels and understand its working.</li> <li>• Dismantle telescopic shock absorber, identify components and draw sketches of components with labels and understand its working.</li> </ul>
06	Visit to automobile service station of heavy vehicle to observe air suspension system, air brakes, power steering system and draw layout. Write a report
07	Visit to Automobile Body Building and Body Manufacturing Industry, Prepare a report considering following points – Layouts, Body Construction, Body Materials, Body Repairs and Painting Procedure.
08	Observe and draw the layout of HVAC system. Measure the ambient temperature and temperature at various locations inside the car. Describe the control systems.

**Notes:**

1. A number of practicals may be started simultaneously.
2. The practicals may be performed in a group of 6 to 8 students.

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

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher / Edition</b>
1	Ramlingam K.K.	Automobile Engineering	Scitech Publication
2	Kirpal Singh	Automobile Engineering	Standard Publication
3	Anil Chikara	Automobile Engineering	Satya Prakashan New Delhi
4	R.B. Gupta	Automobile Engineering	Satya Prakashan New Delhi
5	S. Srinivisan	Automotive Mechanics	Tata McGraw - Hill
6	Crouse / Anglin.	Automobile Mechanics	Tata McGraw - Hill

**2. IS, BIS and International Codes:****3. Websites :** [www.npkauto.com](http://www.npkauto.com)

**Course Name : Mechanical Engineering Group**

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

**Semester : Fourth**

**Subject Title : Theory of Machines**

**Subject Code : 17412**

**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:**

It is a core technology subject in Mechanical Engineering Discipline. Mechanical Engineers often come across various machines in practice. They should be able to identify and interpret various elements of machines in day to day life. In maintaining various machines, a diploma engineer should have sound knowledge of fundamentals of machine and mechanism. It will be helpful for them to understand the mechanisms from operational point of view in a better way. This subject imparts the kinematics involved in different machine elements and mechanisms like gear, cam-follower, follower, belt-pulley, flywheel, brake, dynamometer, clutch, etc.

Detailed knowledge of these aspects with deep insight into the practical applications develops a professional confidence in them to become successful Engineer.

This subject serves as a prerequisite for subjects like Machine Design to be learned in higher semester.

**Objectives:**

**The student will be able to:**

1. Understand different machine elements and mechanisms.
2. Understand Kinematics and Dynamics of different machines and mechanisms.
3. Draw cam profile suitable to various displacement diagram.
4. Select Suitable Drives and Mechanisms for a particular application
5. Understand the function, operation and application of flywheel and governor.
6. Understand the function, operation and application of brake, dynamometer, clutch and bearing

7. Find magnitude and plane of unbalanced forces.

**Theory:**

Topic and Content	Hours	Marks
<p><b>1. Fundamentals and type of Mechanisms</b>            Specific objectives:</p> <ul style="list-style-type: none"> <li>➤ Define various terms related to mechanisms.</li> <li>➤ Explain construction and working of various mechanisms</li> </ul> <p>1.1 Kinematics of Machines:- Definition of Kinematics, Dynamics, statics, Kinetics, Kinematic link, Kinematic pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, inversion, machine and structure. ----- 8 Marks</p> <p>1.2 Inversion of Kinematic Chain</p> <ul style="list-style-type: none"> <li>• Inversion of four bar chain, coupled wheels of Locomotive, Beam engine, Pantograph.</li> <li>• Inversion of single slider Crank chain –Pendulum pump, Rotary I.C. Engine mechanism, Oscillating cylinder engine, Whitworth quick return mechanism. Quick return mechanism of shaper.</li> <li>• Inversion of Double Slider Crank Chain- Scotch Yoke Mechanism, Elliptical trammel, Oldham's Coupling -----8 Marks</li> </ul>	07	16
<p><b>2. Velocity and Acceleration in Mechanisms</b>            Specific objectives</p> <ul style="list-style-type: none"> <li>➤ Draw velocity and acceleration diagram for given mechanism</li> </ul> <p>2.1 Concept of relative velocity and relative acceleration of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceleration.</p> <p>2.2 Analytical method (No derivation) and Klein's construction to determine velocity and acceleration of different links in single slider crank mechanism. -----8 Marks</p> <p>2.3 Drawing of velocity and acceleration diagram of a given configuration, diagrams of simple Mechanism. Determination of velocity and acceleration of point on link by relative velocity method(Excluding Coriolis component of acceleration) ----- 8 Mark</p>	08	16
<p><b>3. Cams and Followers</b>            Specific objectives</p> <ul style="list-style-type: none"> <li>➤ Define the terms related to Cam</li> <li>➤ Classify Cams and Followers</li> <li>➤ Draw cam profile as per the given applications</li> </ul> <p>3.1 Concept, definition and applications of Cams and Followers. Cam terminology</p> <p>3.2 Classification of Cams and Followers.</p> <p>3.3 Different follower motions and their displacement diagrams - Uniform velocity, Simple harmonic motion, uniform acceleration and Retardation. ---- 4 Marks</p> <p>3.4 Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method) -----8 Marks</p>	06	12
<p><b>4. Power Transmission</b>            Specific objectives</p> <ul style="list-style-type: none"> <li>➤ Give broad classification of Drives.</li> <li>➤ Select Suitable Drives and Mechanisms for a particular application</li> </ul>	10	20

<p>➤ Calculate various quantities like velocity ratio, belt tensions, slip, angle of contact, power transmitted in belt drives</p> <p>4.1 Belt Drives- flat belt, V-belt &amp; its applications, material for flat and V-belt. Selection of belts, angle of lap, length of belt, Slip and creep. Determination of velocity ratio of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission (Simple numericals) ----- 8 Marks</p> <p>4.2 Chain Drives- Types of chains and sprockets, velocity ratio. Advantages &amp; Disadvantages of chain drive over other drives, Selection of Chain &amp; Sprocket wheels, methods of lubrication. ----- 4 Marks</p> <p>4.3 Gear Drives – Classification of gears, Law of gearing, gear terminology. Types of gear trains, their selection for different applications. Train value &amp; velocity ratio for simple, compound, reverted and epicyclic gear trains. ....8 Marks</p>		
<p><b>5. Flywheel and Governors ----- 8 Marks</b></p> <p>Specific objectives</p> <p>➤ Differentiate between flywheel and governor</p> <p>➤ Explain with neat sketch the construction and working of various governors</p> <p>5.1 Flywheel –Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C Engine (no Numericals) Coefficient of fluctuation of energy, coefficient of fluctuation of speed and its significance.</p> <p>5.2 Governors- Types, concept, function and application &amp; Terminology of Governors.</p> <p>5.3 Comparison between Flywheel and Governor.</p>	04	08
<p><b>6. Brakes and Dynamometers. ----- 10Marks</b></p> <p>Specific objectives</p> <p>➤ List the differences between brakes and dynamometers</p> <p>➤ Explain with neat sketch the construction and working of various brakes and dynamometers</p> <p>➤ Calculate braking force, braking torque and power lost in friction in shoe and band brake</p> <p>6.1 Function of brakes and Dynamometers, Type of brakes &amp; Dynamometers, comparison between brakes &amp; Dynamometer.</p> <p>6.2 Construction and working i) shoe brake, ii) Band brake iii) Internal expanding shoe brake iv) Disc Brake</p> <p>6.3 Numerical problems to find braking force and braking torque and power for shoe and band brake.</p> <p>6.4 Construction and working of i) Rope brake Dynamometer ii) Hydraulic Dynamometer iii) Eddy current Dynamometer.</p>	05	10
<p><b>7. Clutches and Bearings.</b></p> <p>Specific objectives</p> <p>➤ Explain the difference between uniform pressure and uniform wear theories</p> <p>➤ Explain with neat sketch, the construction and working of various clutches</p> <p>➤ Calculate torque required to overcome friction and power lost in friction in clutches and footstep bearings</p> <p>7.1 Clutches- Uniform pressure and Uniform Wear theories. Function of Clutch and its application, Construction and working of i) Single plate clutch, ii)</p>	06	12



Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch v) Diaphragm clutch, (Simple numericals on single and Multiplate clutches). 7.2 Bearings- i) Simple Pivot, ii) Collar Bearing iii) conical pivot. Torque and power lost in friction. (Simple numericals)		
<b>8. Balancing</b> Specific objectives ➤ Explain the concept of balancing ➤ Find balancing mass and position of plane, analytically and graphically. 8.1 Concept of balancing. Balancing of single rotating mass. Analytical/Graphical methods for balancing of several masses revolving in same plane.	02	06
<b>Total</b>	<b>48</b>	<b>100</b>

**Practicals:****Skills to be developed:****Intellectual Skills:**

1. Determine velocity and acceleration of links in a given mechanism.
2. Analyse balancing of rotating masses in a single plane.
3. Interpret interrelationship between components of various braking mechanisms.
4. Compare various power transmission devices.

**Motor Skills:**

1. Drawing of velocity and acceleration diagrams.
2. Dismantle and assemble given brakes and clutches.
3. Draw cam profiles for a given application
4. Draw velocity and acceleration diagram of the given mechanisms
5. Draw force polygon for unbalanced masses revolving in same plane

**Note** - The Term work shall consist of Journal / lab manual and A-3 size sketch book.

**List of Practical:**

1. Sketch and describe working of quick return mechanism for a shaper. Find the ratio of time of cutting stroke to the return stroke to understand quick return motion in shaping operation.
2. Sketch and describe the working of the following mechanisms with its application,
  - a) Bicycle free wheel sprocket mechanism
  - b) Geneva mechanism
  - c) Ackerman's steering gear mechanism
  - d) Foot operated air pump mechanism
3. Determine velocity and acceleration of various links of the given two mechanism, by relative velocity method for analysis of motion of links.
4. Determine velocity and acceleration in an I. C. engine's slider crank mechanism by Kleins's construction.
5. Draw the profile of a radial cam for the given follower type to obtain the desired follower motion.
6. Determine slip, length of belt, angle of contact in an open belt drive to understand its performance.
7. Draw a schematic diagram of centrifugal governor and describe its working. Draw a graph between radius of rotation versus speed of governor to understand its function.

8. Dismantle and assemble mechanically operated braking mechanism of two wheelers. Sketch the two wheeler braking system and identify the functions of various components.
9. Dismantle and assemble multi-plate clutch of two wheeler. Draw neat sketch and state the functions of various components.
10. Determine graphically counterbalance mass and its direction for complete balancing of a system of several masses rotating in a single plane.

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

Sr. No.	Title	Author	Edition	Publication
01	Theory of Machines	Khurmi Gupta	--	Eurasia publishing House Pvt. Ltd. 2006 edition
02	Theory of Machines	S.S. Rattan	Third	McGraw Hill companies, II Edition
03	Theory of Machines	P.L. Ballaney	--	Khanna Publication
04	Theory of Machines	Jagdishlal	--	Bombay metro-politan book limited
05	Theory of Machines	Sadhu Singh	Second	Pearson
06	Theory of Machines	Ghosh – Mallik	--	Affiliated East west press
07	Theory of Machines	Thomas Bevan	Third	Pearson
08	Theory of Machines	J.E. Shigley	Third	Oxford

**Course Name : Mechanical Engineering Group**

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

**Semester : Fourth**

**Subject Title : Professional Practices-II**

**Subject Code : 17035**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	02	--	--	--	--	50@	50

**Rational:**

The purpose of introducing Professional practices is to fulfill the need of students to stand in today's global market with knowledge and confidence. This can be achieved by arranging industrial visits, expert lectures attitude to present them-selves, get alternative solutions and validation of the selected alternatives, socially relevant activities, and modular courses. Professional Practices is helpful in broadening technology base of students beyond curriculum. Model making exercises allow students to think more creatively and innovatively and inculcating habit of working with their own hands. Modular courses are introduced with a view of learning and acquiring higher technology skills through industry experts and consultants from the respective fields.

**Objectives:**

The student will be able to:

- 1) Acquire information from different sources.
- 2) Prepare notes for given topics
- 3) Present seminar using power projection system.
- 4) Interact with peers to share thoughts.
- 5) Work in a team and develop team spirit.

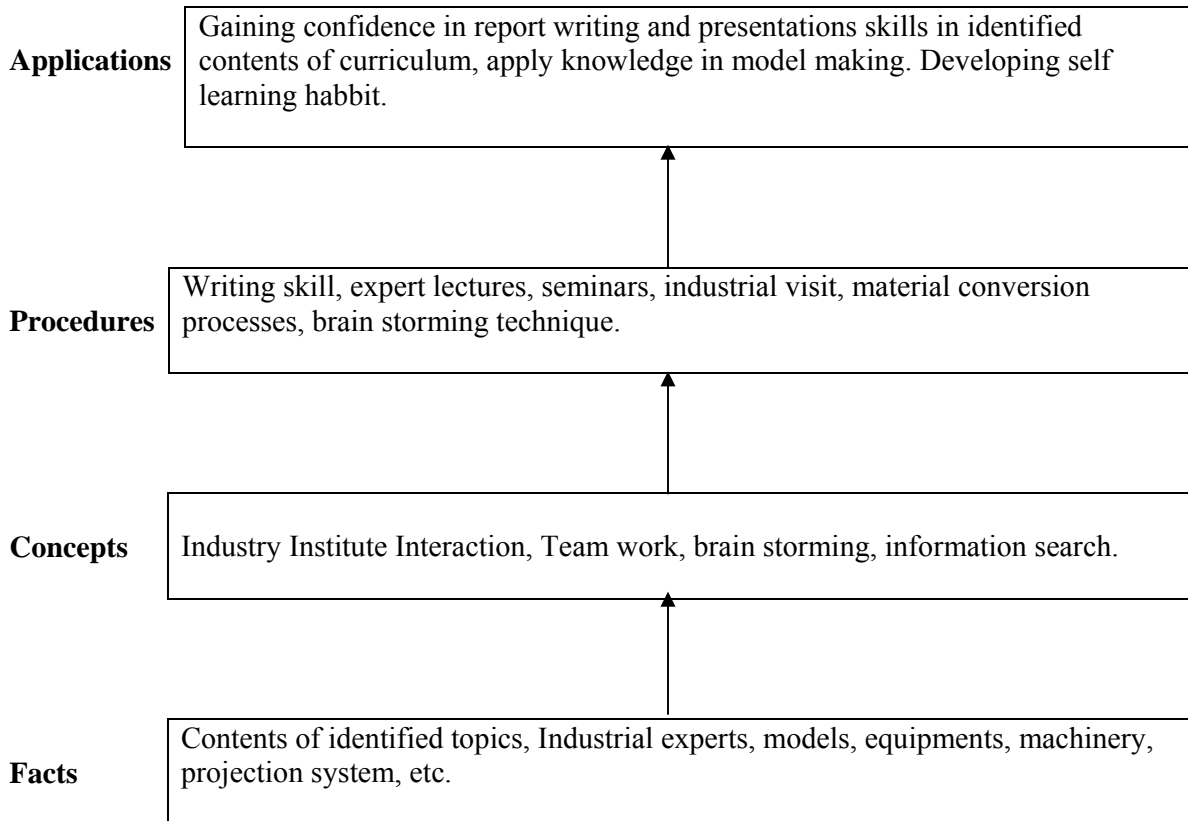
**Intellectual Skill:**

Student will be able to-

- 1) Search information from various resources.
- 2) Prepare notes on selected topics.
- 3) Participate in group discussions.

**Motor Skills:**

- 1) Observe industrial practices during visits.
- 2) Prepare slides / charts for presentation in seminar.
- 3) Develop a model

**Learning Structure:**

**Content:**

Topic & Content	Hours
<p><b>1: Information Search –</b> Information search be made through manufacturers catalogue, Hand books, magazines journal and websites, and submit a report on <b>any Two Topics</b> in a group of 3 to 4 students, report size shall not be more than 10 pages. Following topics are suggested, any other equivalent topics may be selected.</p> <ol style="list-style-type: none"> <li>i) Present scenario of electric power generation in Maharashtra state /India.</li> <li>ii) Composite materials – Types, properties &amp; application</li> <li>iii) Material handling equipments commonly used in industries.</li> <li>iv) Advances in Automobile engines.</li> <li>v) Hydraulic steering systems of Automobile.</li> <li>vi) Mechanisms used to produce straight-line motion.</li> <li>vii) Mechanisms used for generating intermittent motion.</li> <li>viii) Advanced surface coating techniques like chemical vapor deposition, ion implantation, physical vapor deposition.</li> <li>ix) Types of cutting tools- specification, materials and applications.</li> <li>x) Booking of E-Tickets for Railways/Buses/Air travel.</li> <li>xi) Profiles of 2 multinational companies.</li> <li>xii) Engine lubricants, coolants and additives</li> <li>xiii) Power steering, power windows</li> <li>xiv) ABS(anti lock braking systems)</li> <li>xv) MPFI(multi point fuel injection) system</li> <li>xvi) Role of MIDC, MSSIDC, DIC, Financial institutions in development of industrial sector.</li> <li>xvii) Solar energy systems - Components and their functions, applications</li> <li>xviii) Design data book - Study and use of types of data.</li> </ol>	10
<p><b>2. Lectures by professionals/Industry Experts-</b> Two lectures of two hour duration be arranged on any two topics suggested below or any other suitable topics <b>to acquire practical information beyond scope of curriculum.</b> Students shall prepare a brief report of each lecture as a part of their term work.</p> <ol style="list-style-type: none"> <li>i) Components of project Report.</li> <li>ii) Various loan schemes of banks, LIC and other agencies for education and other purposes.</li> <li>iii) Use of plastics &amp; rubbers in Automobiles industries.</li> <li>iv) Type of processes used to protect material surfaces from environmental effect.</li> <li>v) Product life cycle.</li> <li>vi) Industrial application of mechatronics.</li> <li>vii) Special features of CNC machines</li> <li>viii) Gear manufacturing &amp; gear teeth finishing processes.</li> <li>ix) Gear boxes-industrial &amp; Automobile applications.</li> <li>x) Super-finishing operation &amp; their industrial applications.</li> <li>xi) Processing methods for plastic components.</li> <li>xii) Features of modern boilers</li> <li>xiii) Strainers and filters –Types, functions and applications</li> <li>xiv) Industrial drives-Types, components, comparison and applications.</li> <li>xv) Introduction to Apprenticeship Training Scheme</li> </ol>	06
<p><b>3. Seminars:</b> One seminar be arranged on the subjects related to 4<sup>th</sup> semester. Or topics beyond curriculum. Each student shall submit a report up to 10 pages and deliver the seminar. batch size – 2-3 students.</p>	06

<p>Source of information – books, magazine , Journals, Website ,surveys, Topics suggested for guidance-</p> <ol style="list-style-type: none"> <li>i) Clutches- Types, Principles, working, &amp; applications.</li> <li>ii) High pressure boilers.</li> <li>iii) Heat exchangers-Types, working, applications.</li> <li>iv) Hydraulic turbines-Types, working,&amp; applications.</li> <li>v) Hydraulic pumps -Types, working, &amp; applications.</li> <li>vi) Sensors -Types, principle, &amp; applications.</li> <li>vii) Super conductor technology - Types, principle, &amp; applications.</li> <li>viii) Semi conductors-. Types, materials, &amp; applications.</li> <li>ix) Industrial breaks- Types, construction, working, &amp; applications.</li> </ol>	
<p><b>4. Industrial Visits</b> Structured industrial visits be arranged and report of the same shall be submitted by each student to form a part of the term work. No of visits- At least one Scale of industry- medium scale unit, large scale unit. Group size- practical batch Report-not exceeding 7 to 10 pages. Purpose :</p> <ul style="list-style-type: none"> <li>➤ To study the profile of industry</li> <li>➤ To see the advanced manufacturing processes &amp; machinery.</li> <li>➤ To observe working of CNC machines, work centre's ,flexible manufacturing systems</li> <li>➤ To observe working in foundry ,forging shop, press shop, heat treatment shop etc.</li> <li>➤ To observe chip less manufacturing machines &amp; processes.</li> <li>➤ To study process sheets , quality control charts &amp; production drawings, metallurgical testing laboratory</li> <li>➤ To observe Tool room, standards room etc.</li> </ul> <p>Following types of industries may be visited in &amp; around the institute.</p> <ol style="list-style-type: none"> <li>i) Foundry</li> <li>ii) Forging units</li> <li>iii) Sheet metal processing unit</li> <li>iv) Machine/ Automobile component manufacturing unit</li> <li>v) Fabrication unit/ powder metallurgy component manufacturing unit.</li> <li>vi) Machine tool manufacturing unit.</li> <li>vii) Any processing industry like chemical, textile, sugar, agriculture, fertilizer industries.</li> <li>viii) Auto workshop / four wheeler garage.</li> <li>ix) City water supply pumping station</li> <li>x) Hydro electric power plant,</li> <li>xi) Wind mills, Solar Park</li> </ol>	08

<p><b>5. Socially Relevant Activities</b>  Conduct any one activity through active participation of students and write the report.  Group of students- maximum 4  Report- Not more than 6 pages  List of suggested activities- ( activities may be thought in terms of campus improvement)</p> <ol style="list-style-type: none"> <li>i) Awareness about carbon credit</li> <li>ii) Anticorruption movement</li> <li>iii) Awareness about cyber crimes.</li> <li>iv) Developing good citizens.</li> <li>v) Management of E- WASTE</li> <li>vi) Recycling of waste materials.</li> <li>vii) Accident prevention &amp; enforcement of safely rules.</li> <li>viii) Awareness about pollution and pollution control.</li> <li>ix) Any other relevant activity may be performed)</li> </ol>	06
<p><b>6. Mini Projects</b>  Students, in a group of 4, shall perform any one activity listed below.</p> <ol style="list-style-type: none"> <li>i) Model making out of card board paper ,wood ,thermocool, plastics, metal, clay etc <ol style="list-style-type: none"> <li>a) Any new idea/principle converted into model</li> <li>b) Mechanisms</li> <li>c) Jigs/fixtures</li> <li>d) Material handling device,etc.</li> </ol> </li> <li>ii) Toy making with simple operating mechanisms</li> <li>iii) Layout of workshop/department/college</li> <li>iv) Experimental set up/testing of a parameter</li> <li>v) Display board indicating different type of machine components like bearing, fasteners, couplings ,pipe fitting, valves, cams &amp; followers, exploded views of assemblies, type of welding equipment ,welding rods (drawings, photo graphs )</li> <li>vi) Any relevant project which will make students to collect information &amp; work with their own hands.</li> </ol> <p>Students shall arrange exhibition of all mini projects in the class/hall and present the task to the audience/ experts/examiners. The student shall submit a brief report (Max. 5 pages) of the mini project.</p> <p style="text-align: center;"><b>OR</b></p> <p><b>Modular course:</b>  Modular courses on any one of the suggested or equivalent topic be undertaken by a group of 15 to 20 students.</p> <ol style="list-style-type: none"> <li>i) Advance features in CAD</li> <li>ii) Meshing of solid model using any suitable software</li> <li>iii) Developing Unfold Sheet or Hyperblank by using Blanking Software</li> <li>iv) CAM Software</li> <li>v) Basics of PLC programming</li> <li>vi) Applications of mechatronics</li> <li>vii) Piping Technology</li> <li>viii) Modern packaging technology</li> <li>ix) Enterprise Resource Planning</li> <li>x) Bio-pneumatic Robots</li> <li>xi) Bio-mimicry</li> </ol>	12
<b>Total</b>	<b>48</b>

**Note:-**

The students who wish to undergo in plant training shall go through details regarding it in the syllabus of Professional Practices – III for fifth semester and complete the training in summer vacation at the end of fourth semester examination.

All such students will be assessed out of ten marks as per guidelines mentioned in the curriculum of professional practice III in the fifth semester

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

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
01	NRDC, Publication Bi Monthly Journal	Invention Intelligence Journal	National Research Development Corporation, GOI.
02	DK Publishing	How things works encyclopedia	DK Publishing
03	Trott	Innovation mgmt.& new product development	Pearson Education
04	E.H. McGrath, S.J.	Basic Managerial Skills for All – Ninth Edition	PHI
05	Apprenticeship Training Scheme:- Compiled By – BOAT (Western Region), Mumbai, Available on MSBTE Web Site.		

**2. Web sites**

[www.engineeringforchange.org](http://www.engineeringforchange.org)  
[www.wikipedia.com](http://www.wikipedia.com)  
[www.slideshare.com](http://www.slideshare.com)  
[www.teachertube.com](http://www.teachertube.com)



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

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

**Industrial Training (Optional) after 4<sup>th</sup> semester examination.**

**Note:- Examination in Professional Practices of 5<sup>th</sup> Semester.**

### **INDUSTRIAL TRAINING (OPTIONAL)**

**Rational:-**

There was a common suggestion from the industry as well as other stakeholders that curriculum of Engineering and Technology courses should have Industrial training as part of the curriculum. When this issue of industrial training was discussed it was found that it will be difficult to make industrial training compulsory for all students of all courses as it will be difficult to find placement for all the students. It is therefore now proposed that this training can be included in the curriculum as optional training for student who is willing to undertake such training on their own. The institutes will help them in getting placement or also providing them requisite documents which the student may need to get the placement.

**Details:-** Student can undergo training in related industries as guided by subject teachers / HOD.

- The training will be for four weeks duration in the summer vacation after the fourth semester examination is over.
- The student undergoing such training will have to submit a report of the training duly certified by the competent authority from the industry clearly indicating the achievements of the student during training. This submission is to be made after joining the institute for Fifth semester.
- The student completing this training will have to deliver a seminar on the training activities based on the report in the subject Professional Practices at Fifth Semester.
- The student undergoing this training will be exempted from attending activities under Professional Practices at Fifth semester except the seminar.
- The students who will not undergo such training will have to attend Professional Practices Classes/activities of fifth semester and will have to complete the tasks given during the semester under this head.
- There work will be evaluated on their submissions as per requirement and will be given marks out of 50. Or student may have to give seminar on training in Industry he attended.
- Institute shall encourage and guide students for Industry training.
- Evaluation:- Report of Training attended and delivery of seminar and actual experience in Industry will be evaluated in fifth semester under Profession Practices-III and marks will be given accordingly out of 50.