







# **CURRICULUM REVISION PROJECT**

**2012**

**TEACHER GUIDE FOR**

(Heat Power Engineering (17407))

**FOURTH SEMESTER AUTOMOBILE ENGINEERING  
GROUP**

**DECEMBER 2013**



**MAHARASHTRA STATE  
BOARD OF TECHNICAL EDUCATION, Mumbai**  
(Autonomous) (ISO 9001:2008) (ISO/IEC 27001:2005)

# 1. APPROACH TO CURRICULUM DESIGN

## 1.1 Background:

MSBTE is introducing the revised curriculum under 'G' scheme from the academic year 2012-13.

There are many institutions in the state running different diploma courses. In order to ensure uniform and effective implementation of the curriculum it is necessary that every teacher is aware of approach for curriculum design, educational principles to be adopted, learning resources to be used and evaluation methods. The teacher guide prepared for each subject will provide the inputs related to above mentioned aspects to achieve uniform and effective implementation of curriculum of various subjects.

## 1.2 CURRICULUM PHILOSOPHY

MSBTE has adopted systems approach while designing the scientific based curriculum since 1995. The same approach has been adopted while revising the curriculum in semester pattern.

Fig. No. 1 shows the systems diagram. This diagram provides the holistic view for curriculum designing, development, implementation and evaluation

The input to polytechnic education system is the students having 10+ qualifications. The teaching learning process occurs in the institution for six/eight semesters. The output of the system i. e. Diploma pass out is normally the input to industries. (Some students do go for higher education). While designing the curriculum the expectations of the industries play a major role. Due to globalization and competition the industries expect that pass outs have generic and technological skills along with right attitude.

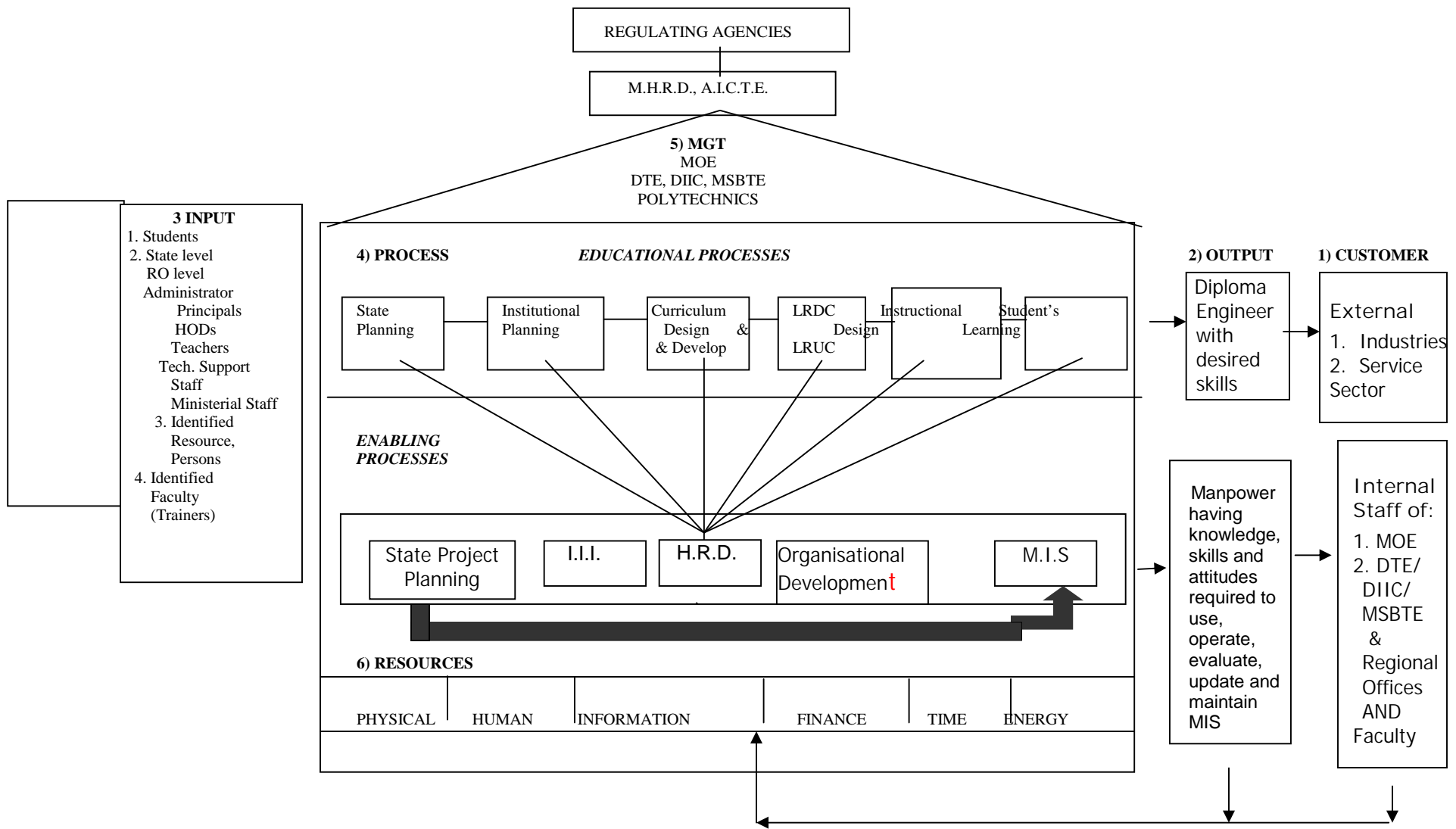
To fulfill the needs derived from systems approach following conceptual framework is considered:

## 1.3 Curriculum:

**“Curriculum is an educational program designed and implemented to achieve specified educational objectives”**

This definition takes into account the fact that

- Education is purposeful
- There is an organized plan of action contemplated
- Such a plan is translated into action through appropriate strategies of implementation.



**Fig 1 Systems Approach**

#### **1.4 Curriculum goals**

1. To develop confidence in students by providing more exposure to industry experience and world of work at global level
2. To provide conceptual knowledge and develop analytical ability
3. To develop communication skill with good English by providing sufficient practice
4. To enhance latest technical knowledge industry interaction and media
5. To develop learning to learn skills and life skills to cope up with industrial culture
6. To impart managerial skills by providing appropriate theoretical inputs
7. To develop problem solving ability through technical projects.

#### **1.5 DESIRED SKILLS**

Industries expect from the diploma engineer the abilities and skills of general nature and specific to the job performance. The curriculum aims at developing life skills and technological skills so that the diploma pass outs would be suitable for industry. The skills are listed below:

##### **Life Skills:**

- Search information from various sources
- Develop communication ability
- Develop Presentation skill
- Work as a member of a team/group and as leader
- Collect field data
- Develop Learning to learn
- Write report for given task/work/project
- Develop computer proficiency
- Develop observation skills

##### **Technological Skills:**

Diploma engineers should possess following Technological skills in order to satisfactorily perform duties assigned to them:

##### **A) Intellectual Skills:**

- 1) Read and interpret Automobile Engineering drawings.

- 2) Prepare spares and labor estimates for vehicle service.
- 3) Carryout loss assessment of accident vehicle.
- 4) Design simple automobile engineering components.
- 5) Prepare job card and warranty report.
- 6) Plan, execution of various vehicle service activities.
- 7) Test vehicle repair quality, prepare reports and interpret them.
- 8) Use various automobile engineering software.
- 9) Follow various standards and codes.
- 10) Maintain records in various formats.
- 11) Carry out vehicle scheduled and breakdown maintenance.
- 12) Maintain fleet of vehicle and keep transport related documents.
- 13) Supervise service and production work.
- 14) Select appropriate technique for quality control.

**A) Motor Skills.**

- 1) Prepare manual and Computer generated Automobile engineering drawings.
- 2) Use measuring instruments and prepare inspection reports.
- 3) Handle testing of equipments.
- 4) Lay out of different types of vehicle.
- 5) Draw free hand sketches of automobile components.

**1.5 Salient Changes in the curriculum:**

- ❖ For First Semester Basic Science is divided into two parts- Basic Physics and Basic Chemistry. Theory examination of both parts as well as practical examination of both parts will be conducted on separate days. Sum of theory marks of both parts shall be considered for passing theory examination of Basic Science. Similarly it is applicable to practical examination. It is mandatory to appear for theory and practical examination of both parts. Candidate remaining absent in any examination of any section will not be declared successful for that exam head.
- ❖ For second semester Applied Science is divided into two sections- Applied Physics and Applied Chemistry where the theory examination of 50 marks each and practical examination of 25 Marks each will be conducted separately and the minimum passing

marks for Engineering Science will be the combination of both the sections. . It is mandatory to appear for theory and practical examination of both parts. Candidate remaining absent in any examination of any section will not be declared successful for that exam head.

- ❖ The components of Development of Life Skills were taught in two semesters. In Development of Life Skills –I the topics related to personal development, such as Learning to Learn Skills, personality development, presentation skills etc. were included. In Development of Life Skills – II the topics related to Team Building, Leadership, group behavior etc. were covered. In the revised curriculum the scope of development of life skills has been broaden to include behavioral science component. Therefore the subject Development of Life Skills – II has been renamed and it is now included at Vth Semester in the revised curriculum under the title Behavioral Science.
- ❖ The subject of Professional Practices was introduced to integrate the skills acquired in Development of Life Skills, through technical subjects from second to sixth semester. The experience in implementing the contents of the subject shows that there are limited activities possible in second semester as the technical knowledge given to the students is very limited. Also at sixth semester the student are doing projects in which they are performing many activities included in the Professional Practices and therefore it is proposed that the subject of Professional Practices be prescribed only for three semesters vis. Third, fourth and fifth semesters.
- ❖ Introduction of Environment Engineering at fourth Semester for all courses
- ❖ From the experience of implementation of Elective Subjects at V and VI semesters in last five years, it is proposed to have only one elective either at the fifth and sixth semesters for all courses. However the specialized courses like Medical Electronics, Electronics and Video Engineering will not have provision for electives. For elective, student will have to choose one from the given two/three subjects.
- ❖ While revising the curriculum redundant /obsolete topics/sub topics are being replaced by new/advance technology topics/sub topics.
- ❖ In Mechanical Engineering Group CADD, 3D Modelling, CNC Machines, Engine Maintenance (AUTO) are introduced as independent subjects.
- ❖ In Civil Engineering Group CAD has been added as an independent subject.

- ❖ In Electronics Engineering Group simulation software has been introduced, weightage of Microprocessors is reduced and more weightage is given to Microcontrollers, topics on PLC and SCADA are added, contents of discrete circuits are reduced and emphasis is given on integrated circuits.
- ❖ In Electrical Engineering new topic of LED lighting has been added in Illumination Engineering subject. Similarly introduction of residential solar lighting systems, topics like duties and responsibilities of Electrical Inspector, Commercial aspects of power utilities have also been added. Heating, Ventilation & Air-conditioning (HVAC) has been deleted from the revised curriculum. Subject of Power System Operation has been introduced at VI Semester Electrical Course also.
- ❖ In Automobile Engineering, new subjects like 2-Wheeler Technology, Auto-tronics . Solid modeling, Cad (Auto) are introduced.

## **2. OBJECTIVES**

### **2.1 Introduction**

Objectives are the statements which describe the expected learning outcome. Such statements enable teachers to plan instructional process with appropriate resources. These objectives also provide a direction to frame proper questions to assess the learning outcome. During last decade there has been research on cognitive approach in psychology. This approach is based on biological structure of brain and meta-cognitive knowledge dimension. Important elements of this approach which form basics of learning are explained below.

### **2.2 Domains of Learning:**

Learning is a process by which students develop relatively permanent change in mental associations through experience. This is how learning is defined by cognitive psychologists. Behavioral; psychologists define learning as a relatively permanent change in behavior.

There are following domains of learning:

- A: Cognitive Domain relates to intellectual skills or abilities
- B: Affective Domain relates to emotions, feelings, likes, dislikes etc.
- C: Psychomotor Domain relates to manipulative skills of hands, legs. Eye-hand coordination in Engineering & Technology courses, endeavor is made to design curriculum with a focus on development of cognitive skills through classroom teaching. Where as manipulative (psychomotor) skills are developed in workshops, laboratories & seminars where students work individually or in a group. Development of affective skills attitudes and value is supposed to be acquired through projects and co curricular activities. These are also developed from the work culture or institutions.

How far a student has developed these abilities/skills especially from cognitive and psychomotor domains is assessed on the basis of suitable examinations. When classroom and laboratory teaching is viewed in this light, evaluation becomes an integral part of teaching – learning process.

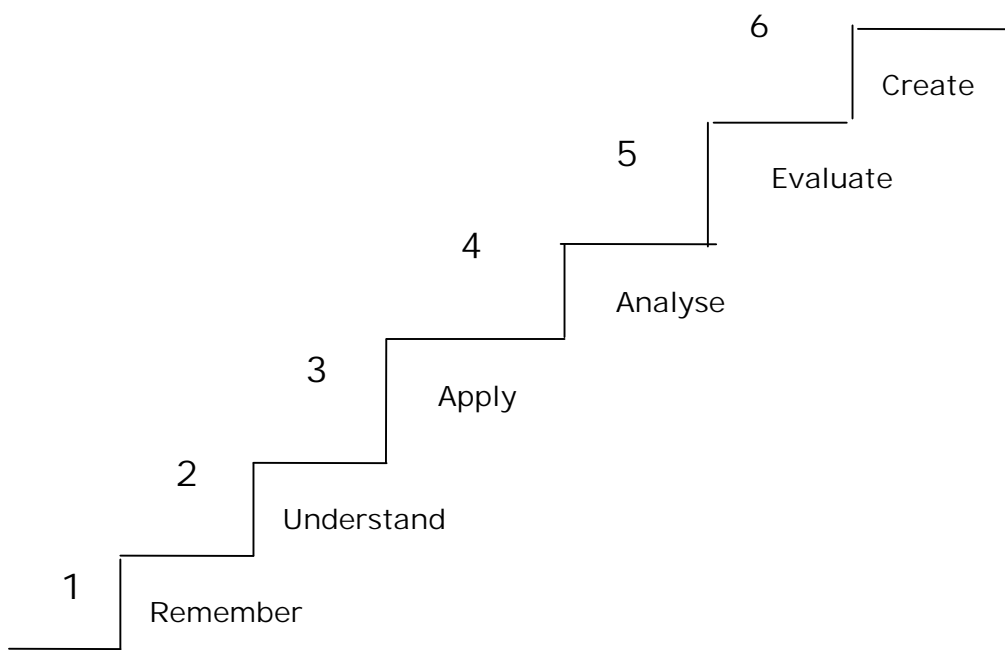
### **2.3 LEVELS OF LEARNING:**

Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for the purpose of writing objectives and assessment. Dr. Bloom's revised taxonomy is based on cognitive psychology and is two dimensional. First dimension is cognitive process dimension and other is knowledge dimension. Details of these two dimensions are given below.

#### **2.4.1 Cognitive Domain:**

Dr. Benjamin Bloom (1956) analysed questions asked in various examinations in American situation and proposed a hierarchical arrangement of instructional objectives (Intellectual abilities) tested by these questions.

The lowest level of cognitive learning achieved by a student is demonstrated by the recall of information that the student retrieves from his long term memory. So, the storage and retrieval of specific facts, concepts, principles, laws, definitions, properties, procedures etc. directly from memory was classified as a knowledge level objective. Thus questions testing memory of students were treated as at the lowest level of the hierarchy of intellectual abilities. The other levels of hierarchy proposed by Dr. Bloom in 1956 relate to the degree of information processing required in the brain needed to provide answer to a question. The various levels in the cognitive hierarchy proposed by Dr. Bloom in 1956 and further revised in 2001 are given below in the diagrammatic form.



Following are the details of each level which indicate the general and specific objectives. Further appropriate verbs are given which are useful in setting good questions. In this table only four levels are considered for diploma students.

Description of the Major Levels in the cognitive Domain (Bloom's Taxonomy)	Illustrative General Instructional Objectives	Illustrative verbs for stating specific learning outcomes
<b>Remember</b> – Knowledge is defined as the remembering of previously learned material. This may involve the recall of a wide range of material, from specific facts to complete theories, but all that is required to mind of the appropriate information. This represents the lowest level of learning outcomes in the cognitive domain	Knows common terms, specific facts, basic concepts, principles, methods & procedures	Define, describe, identify label, list, match, name, outline, reproduce, select, state
<b>Understand</b> – This is defined as the ability to grasp the meaning of material. This may be shown by translating material from one	Understands fact, principles Interprets verbal material,	Convert, distinguish estimate, explain,

form to another (words or numbers) by interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects). Draw sketches these learning outcomes go one step beyond the simple remembering of material and represent the lowest level of understanding.	Interprets charts, tables, graphs. Translates verbal material to mathematical formula. Estimates consequences implied in data. Justifies methods & procedures.	extend, generalize, give examples; infer, paraphrase, predict, rewrite, summarize, draw labeled sketches.
<b>Apply</b> – Application refers to the ability to use learned material in new and concrete situations. This may include the application of such things as concepts, principles, rules, methods, laws and theories. Learning outcomes in this area require a higher level of understanding than those under the level described earlier.	Applies principles to new situations. Applies theories to practical situations. Solves mathematical problem. Construct charts, graphs Demonstrates correct usage of a procedure	Change, compile, demonstrate, discover manipulate, modify operate, predict, prepare, produce, show, solve, use.
<b>Analyze</b> – Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of the parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than “understand” and apply because they require an understanding of both the content and the structural form of the material.	Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/ adequacy of data.	Breakdown, diagram, differentiate, discriminate, distinguish, identify illustrate, infer, outline, point out, relate, select, separate, subdivide.

#### 2.4.2 Categories of Knowledge Dimension

After considering the various designations of knowledge types, especially developments in cognitive psychology that have taken place since the original framework of Bloom’s taxonomy, knowledge is categorised in 4 types – Factual , Conceptual, Procedural and Meta-cognitive.

*Factual Knowledge (A)* is knowledge of discrete, isolated content elements. It includes knowledge of terminology and knowledge of specific details and elements. In contrast,

*Conceptual Knowledge (B)* is knowledge of “more complex, organised knowledge form”. It includes knowledge of classifications and categories, principles and generalizations and theories, models and structures.

*Procedural Knowledge (C)* is “knowledge of how to do something”. It includes knowledge of skills and algorithms, techniques and methods, as well as knowledge of criteria used to determine and/or justify “when to do what” within specific fields and disciplines.

*Meta-cognitive knowledge (D)* is “knowledge about cognition in general as well as awareness of and knowledge about one’s own cognition. It encompasses strategic knowledge, knowledge about cognitive tasks, including contextual and conditional knowledge; and self-knowledge”.

Assessment is required to be done on the basis of categories of knowledge and levels of learning. Table below indicates the two dimensional grid based on Blooms Taxonomy for setting questions.

Knowledge Dimension	COGNITIVE PROCESS DIMENSION			
	1 Remember	2 Understand	3 Apply	4 Analyze
A. Factual Knowledge				
B. Conceptual Knowledge				
C. Procedural Knowledge				
D. Meta-cognitive Knowledge				

## 2.5 Components of Curriculum:

**2.5.1 Rationale:** It indicates the logical basis for the inclusion of the subject in the curriculum. It also indicates the importance of the subject related to entire curriculum.

Rationale tells the students the connection of subjects related to study of higher level subjects and also the use in their job/profession.

**2.5.2 Objectives:** Objectives indicate what the student will be able to do/perform after he/she completes the study of the subject. It also in other words indicates the scope of the subject.

Objectives indicate what is achievable and hence give direction to the student about how to study the subject, what important things are to be observed and performed during practicals.

Just as rationale indicates the use of the knowledge gained while studying the subject, objectives indicate how efficiently and effectively one can work if the objectives are fulfilled while studying the subject.

**2.5.3 Learning Structure:** It graphically/pictorially indicates the content of the curriculum of the subject and what is to be learnt in the subject. As you know that Cognitive Domain knowledge is divided in four components as mentioned in the Two dimensional grid. Of this Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the applications.

Facts, Concepts, Principles are used in developing procedures and applications. So these are given sequentially below procedure as Principles, Concepts and Facts in their order. Learning structure also provide an idea about how to develop the subject logically to achieve the objectives.

**2.5.4 Contents:** List of topics and subtopics to be included in the curriculum of the subject is given in the contents. This helps in achieving the rationale and objectives identified. Contents indicate the importance of the topics, sub topics in development of the subject and accordingly weightages in terms of Hours required to teach the subject components, so that the desired learning takes place. Marks to be allotted while testing the knowledge gained by the student are also indicated.

### **2.5.5 Practicals**

The skills will be developed if the students actually perform certain activities or tasks. Therefore it is necessary that any practical included in the curriculum necessarily involve some activities to be done by the students. So one has to think and innovate to modify the study experiments so that students will be asked to perform some activity. It could be in terms of identifying components, listing of materials used for manufacturing the components, stating importance of use of certain materials etc.

So any curriculum of a subject is so designed that it achieves the objectives of that subject as well as fulfill the objectives of the entire curriculum

: While designing the curriculum the objectives are identified. To achieve these objectives students have to develop certain intellectual and motor skills. These skills are developed through well designed Practicals. So in the curriculum the list of the skills to be developed through Practicals is given. The list of Practicals is so developed that after performing the Practicals identified skills will be developed. Here it is necessary that the teacher gives enough opportunity to all the students to perform the practical properly to develop the skills in each one of them.

### **3. CONTENT ANALYSIS**

#### **3.1 Components of Content Analysis:**

As we have discussed earlier, any curriculum or syllabus of a SUBJECT given to the teacher is organised in terms of UNITS which include TOPICS or SUB-TOPICS as the case may be indicating the TIME in which it is expected to be taught to the students. Components of a topic or part thereof are analysed here at a micro level.

Before we begin actual teaching of any topic (lesson), we must carefully and critically analyse it so that we can plan for teaching - select appropriate media, methods and techniques of teaching and arrange the suitable resources to be required. This analysis of the content of a Topic results in identification of the following components of the content:

1. Facts
2. Concepts
3. Principles (rules, laws, theories)
4. Applications
5. Procedures
6. Skills (Psychomotor Skills), and
7. Attitudes (underlying affective behaviors as quite often these are not specifically mentioned in the curriculum, still they are to be developed lesson after lesson gradually).

When we undertake the exercise of content analysis, we ourselves understand the subject fully well and at the same time we become clear as to what we are going to teach. It also gives us an idea as to which methods of teaching and media of instruction we should prepare and use and also what resources including time we will require. This analysis will also enable us to design assignments as well as how we are going to assess students learning.

Since the nature of the components of content (1 to 7) differs from one another. These are learned by the students differently as different mental processes are involved in learning these

components. The immediate implication of this varying nature of components is that these need to be taught differently and assessed differently. For example, if you look at components 1 to 5 all of which belong to Cognitive Domain of Learning; Component 6 belongs to Psychomotor Domain and Component 7 belongs to Affective Domain (cannot be taught as these attitudes are caught), you will find that these differ from one another. The classification of human behaviors (activities) into the above three domains of learning entails the use of entirely different methods and media of instruction. Different locations of learning (classroom, laboratories, workshops, field visits) need to be selected.

Now we will discuss these components in some detail and see how each one of these should be taught and assessed differently.

### **3.1.1 FACTS:**

These are universally accepted and commonly understood items about which there cannot be much argument and discussion. These are required only to be informed. For example: The sun rises in east and sets in the west; names of scientists and the year in which their theories were propounded; the rules and regulations of admission and examination prescribed by the University are some of the examples of facts. Sometimes, they need not be emphasised in the class as the students already know them. But information can be passed on by word of mouth, if deemed necessary.

### **3.1.2 CONCEPTS:**

A concept is an abstraction or an idea that permits the learner to classify a variety of related phenomena into a convenient and meaningful category. Concept of something is like a picture formation of that thing which helps in conceptualizing it. Gagne says that concept learning produces a certain fundamental change in human performance that is independent of subject or content. Concepts can be divided into the following two categories:

- 1. Concrete Concepts:** those which can be seen, touched and manipulated e.g. house, book, table, chair, cat, dog, any machine or apparatus, overhead projector, chalkboard and duster.

**2. Abstract Concepts:** those which cannot be seen and touched and handled but can only be imagined e.g. force, work, fractions, decimal, bending moment, moment of inertia, friction, heat, and induction. Teaching of concrete concepts is not that difficult because the teacher can show the object physically or its picture. On the contrary, teaching of an abstract concept offers difficulty to the teacher as well as for students to understand. These concepts can be learned by heart without understanding as children mug up Nursery Rhymes without understanding even a single word. But at the stage of higher learning, this type of rote learning is not desirable. Adolescents (teenagers) and adults do not accept things without understanding.

### **3.1.3 Concept Attributes:**

We identify a concept and understand it, once we are told about its qualities characteristics, and features. They are technically called concept attributes. While teaching a concept to our students we must spell out as many attributes as possible for better understanding of the concept.

**Example:** The Concept of Friction

#### **Attributes:**

1. Friction is a resistive force.
2. Frictional force acts in the direction opposite to the direction of the applied force.
3. Frictional force is more when the surfaces in contact are rough.
4. Smooth surfaces (perfect) have zero friction.
5. Frictional force is self-adjusting to a limit.

Towards the end of this Theme Paper a number of examples of concept attributes are given for your guidance.

The following questions pertaining to a concept (object or process) will be helpful in writing concept attributes:

1. What it is.
2. What are its constituent parts.
3. How it works.
4. How it is similar to and different from other known concepts.

5. What are its uses?

### **3.1.4 PRINCIPLES:**

A principle is a statement of relationship between two or more concepts. Principles are sometimes called rules, laws or generalizations. In others words, relationship between two or more concepts which is scientific and universally true is called a Principle.

*For Example:* (related concepts are underlined>)

1. Actions and reactions are equal and opposite.
2. Ohm's law  $I = V/R$  is a principle, where I (Current), V (Voltage), and R (Resistance) are the concepts. While teaching a principle we must recall the concepts which it involves. These concepts might have been taught in the previous lesson. As you already know, concept learning is a prerequisite to Principle learning. Thus we recall the concepts of current, voltage and resistance by asking questions to the students. Only after that we must tell the relationship among these i.e. Ohm's Law.

### **3.1.5 APPLICATIONS:**

Whatever principles, laws and theories have been learned are only academic exercises unless these are applied to solve a practical problem. In other words, we call this application transfer of learning to a new situation. If you recall, the process of learning dealt with in Theme Paper 2, you will appreciate that the litmus test of learning having occurred is its application in a new situation or solving a new problem.

*For example:*

1. Ohm's law can be applied to find out the unknown quantity (voltage, current, and resistance).
2. Design of a structure can be made based on related principles and theories.
3. Principles of learning and events of instruction can be applied in 'Designing a lesson Plan' and 'Presenting the lesson in the classroom'.
4. The above principles can also be applied while preparing textbooks, workbooks, learning packages and laboratory manuals to be used by the students.

### **3.1.6 PROCEDURES:**

While analysing the content of a topic you might come across certain standard procedures which are prescribed to perform an operation or a given task. These procedures should be clearly identified and taught accordingly not to be left to chance. We should not pre-suppose that the students understand them. We cannot afford to take these things for granted.

***For Example:***

1. Procedure of setting up of an apparatus.
2. Procedure to start an engine.
3. Procedure to operate a machine (a lathe).

**3.1.7 SKILLS (PSYCHOMOTOR):**

A skill is an ability to perform a task expertly and well. The skilled performance; must meet a pre-specified standard of acceptable performance. A skill has the following three characteristics:

1. It represents a chain of motor responses;
2. It involves the co-ordination of hand and eye movements, and
3. It requires the organization of chains into complex response patterns.

Skills could be intellectual (thinking, understanding); interactive (communication skills) and social (socialising, mixing up with others) also. But normally when we use the word skills, it refers to psychomotor skills.

***For Example:***

1. Welding a butt joint,
2. Setting a theodolite at a station,
3. Making proper circuit connections, and
4. Turning a job on a lathe machine.

Laboratories and workshops of Polytechnics are the locations where these skills are developed among the students under the guidance of expert instructors *of* operators. Drill and practice are the main methods of teaching and learning these skills through model demonstrations and careful observations thereof.

Alongside developing these skills, desirable attitudes like cooperation, team work, leadership, safety, cost consciousness are also developed.

### **3.2 TEACHING OF CONCEPTS;**

In order to teach concepts effectively the following steps have been suggested by De Cecco & Crawford (1974).

#### **Steps Suggested:**

1. Describe the performance expected of the student after he has learned the concept.
2. Reduce the number of attributes to be learned in complex concepts and make important attributes dominant.
3. Provide the student with verbal indicators (explanation).
4. Provide positive and negative examples (non-examples) of the concept.
5. Present the examples in close succession or simultaneously.
6. Provide occasions for student responses and the reinforcement of these responses, and
7. Assess the learning of the concept.

### **3.3 TEACHING OF PRINCIPLES:**

De Cecco & Crawford (1974) has suggested the following steps for teaching principles effectively.

#### **Steps:**

1. Describe the performance expected of the student after he has learned the principle.
2. Decide and indicate which concepts or principles the students must recall in learning the new principle.
3. Assist the student in the recall of component concepts.
4. Help the student in the recall of component concepts.
5. Help the student to combine the concepts and put them in a proper order.
6. Provide for practice of the principle and for reinforcement of student responses.
7. Assess the learning of the principle.

### **3.4 CONCLUSION:**

To sum up, it can be said that. it is essential for the teachers to develop the skills of 'Content Analysis' of their subjects. It brings content clarity among teachers themselves. More importantly, Content Analysis will be a pre-requisite for writing Instructional Objectives of the topic to be taught. You will study Instructional Objectives in a separate Theme Paper in detail. Teaching and learning process is bound to be effective once these crucial academic activities are undertaken.

#### 4. CURRICULUM:

**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.

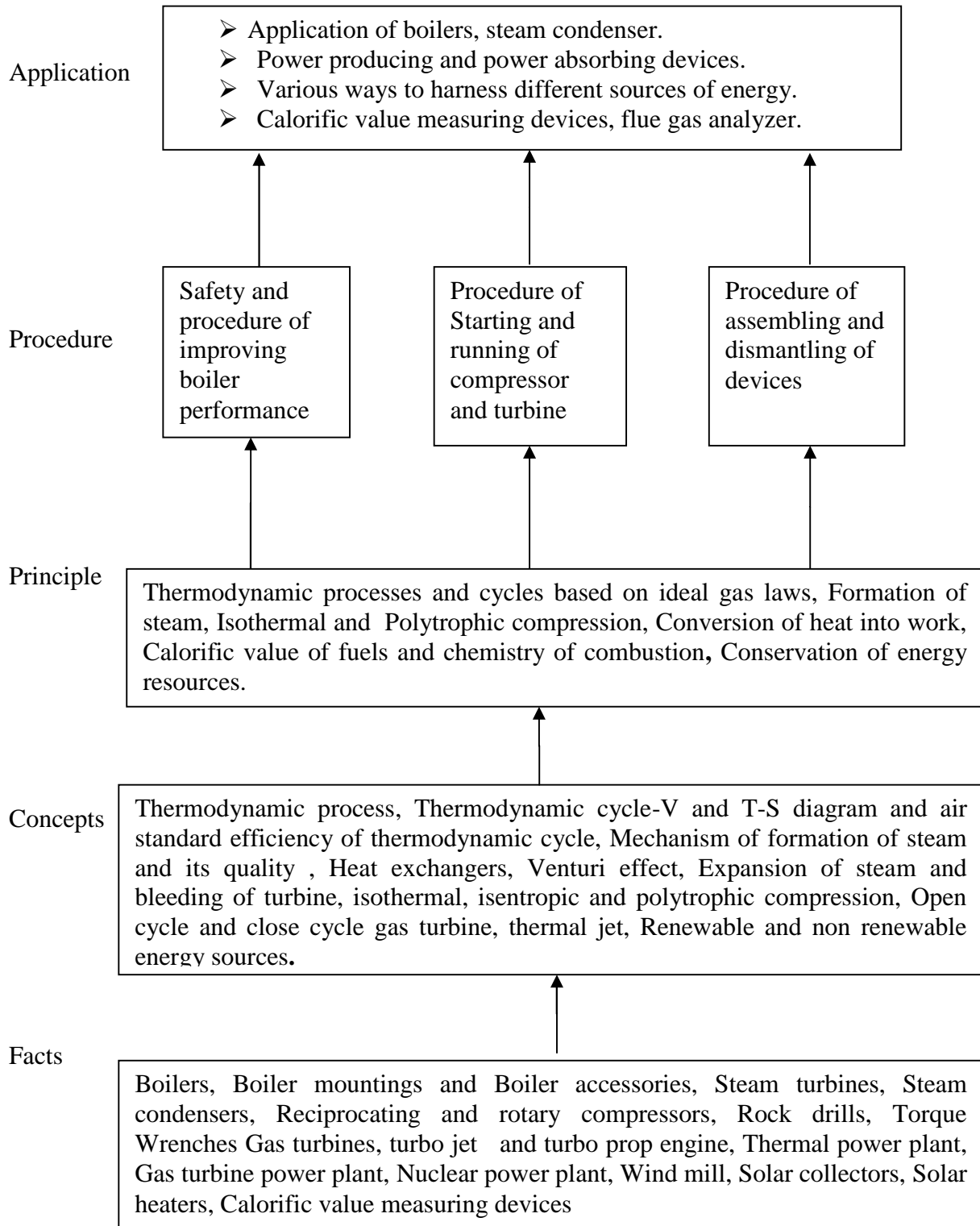
#### **Objectives:**

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:**

<b>Topic and Content</b>	<b>Hours</b>	<b>Marks</b>
<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 style="padding-left: 20px;">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</p>	08	18

<p>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 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.</p> <p>3.3 Applications of compressed air: construction and working of i) Rock drill, ii) pneumatic torque wrench</p>		
<p><b>4. Gas Turbines</b> <span style="float: right;"><b>14 Marks</b></span></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know the working of gas turbine and its application in aviation industries.</li> </ul> <p>Content:</p> <p>4.1 Brayton cycle - P.V. diagram and thermal efficiency. <span style="float: right;"><b>4 Marks</b></span></p> <ul style="list-style-type: none"> <li>• Classification of gas turbines.</li> </ul> <p>4.2 Construction and working of gas turbines i) open cycle, ii) closed cycle gas Turbines, P.V. and T.S diagrams. <span style="float: right;"><b>10 Marks</b></span></p> <ul style="list-style-type: none"> <li>• Turbojet and turboprop engine.</li> </ul> <p><b>(no numerical)</b></p>	06	14
<p><b>5. Sources of Energy and Power plants</b> <span style="float: right;"><b>16 Marks</b></span></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know various sources of conventional and non-conventional energy with their applications.</li> </ul> <p>5.1 Classification of various conventional and non-conventional sources of energy. Construction and working of power plants based on conventional energy sources like :</p> <ol style="list-style-type: none"> <li>a) Thermal power plant</li> <li>b) Gas turbine power plant</li> <li>c) Nuclear power plant -Pressurized water reactor. <ul style="list-style-type: none"> <li>• Parameters for the site selection of conventional power plants.</li> </ul> </li> </ol> <p>5.2 Power plants based on non-conventional energy sources.</p> <ol style="list-style-type: none"> <li>i) Solar, ii) Biomass, iii) Wind energy <ul style="list-style-type: none"> <li>• Concepts of Geothermal and tidal power plant.</li> </ul> </li> </ol>	08	16
<p><b>6. Fuels and Combustion</b> <span style="float: right;"><b>16 Marks</b></span></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Know the comparative information of properties of various fuels.</li> <li>➤ Know the chemistry of combustion of fuels.</li> <li>➤ Calculate H.C.V./L.C.V of fuels and requirement of theoretical or minimum air required for combustion of fuel.</li> </ul> <p>Content:</p> <p>6.1 Types of fuels – <span style="float: right;"><b>4 Marks</b></span></p> <p>Definition, classification, properties, Calorific value of fuels.</p>	08	16

<ul style="list-style-type: none"> <li>• Ultimate analysis and proximate analysis of solid fuels.</li> <li>• Liquid fuels- Comparative information about composition, specific gravity and gross calorific values of liquid fuel.</li> <li>• Gaseous fuels- natural, LPG, CNG, and other artificially prepared gaseous fuels.</li> </ul>		
6.2 Higher and lower Calorific values of fuel and it's 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>		
<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)

## 5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic I	<b>Fundamentals of thermodynamics.</b>		
	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	1.Heat Engines 2.Power absorbing devices	Explain with chalk board initially. Also show the models available at laboratory
	<b>CONCEPT</b>	1. Change in internal energy. 2. Change in enthalpy. 3. Thermodynamic process. 4. Modes of heat transfer.	Explain with chalk board initially. Giving day to day examples from actual life.
	<b>PRINCIPLE</b>	1. Isobaric, isochoric, isothermal, adiabatic, polytrophic process. 2. Carnot cycle, Otto cycle, Diesel cycle, Dual combustion cycle. 3. Conduction, convection and radiation.	Explain with chalk board initially. Show the piston cylinder model to explain cycles, Asking the general question to the students regarding heat transfer e.g. what will be the effect on your bike while you are start in winter season and in summer season? etc.
	<b>PROCEDURE</b>	Determination of various efficiency by using the relevant formulae	Explain with chalk board initially. Solve the numerical in class. Give some problem as an assignment.
<b>APPLICATION</b>	Heat engines, Thermal power plant	Explain with chalk board initially. Also show some related videos and discuss.	
<b>Learning Resources</b>			
<b>Books:</b>			
<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
1	R. S. Khurmi and J. K.Gupta	A Text book of Thermal Engineering	S. Chand and Co. Ltd.
2	A course in Thermal Engineering	S. Domkundwar, Dr C.P.Kothandaramanand A.V.Domkundwar	Dhanpat Rai and Co.(P)Ltd, New Delhi
<b>Teaching Aids:</b> Models, charts, Actual machine power points.			
<b>PPT with Sample:</b> Available on Google search.			
<b>Websites:</b>			
www.howstuffworks.com			
www.wikipedia.com			

	www.watertubeboiler.org www.scince.uwaterloo.ca
Lecture No.	Topic/ Subtopic to be covered
1	<b>Study of thermodynamic processes for ideal gases</b> Represent Isobaric, Isochoric, Isothermal, Adiabatic and polytrophic processes on P-V and T-S diagram,
2	Represent Adiabatic and polytrophic processes on P-V and T-S diagram, formulae of work done,
3	change in Internal energy and change in enthalpy.
4	Relation between P,V and T (Derivations only for adiabatic process, No mathematical calculations for any process)
5	Air cycles: P-V and T-S diagram and equations for air standard efficiency of <ul style="list-style-type: none"> <li>• Carnot Cycle</li> <li>• Otto combustion Cycle.</li> </ul>
6	Air cycles: P-V and T-S diagram and equations for air standard efficiency of <ul style="list-style-type: none"> <li>• Diesel and</li> <li>• Dual combustion cycle.</li> </ul>
7	Fundamental of Heat transfer Modes of heat transfer – conduction, convection and radiation
8	Application of heat transfer in automobiles
9	Review,practice,feedback and question bank

Topic 2	<b>Name: Properties of Steam and Steam Power</b>		
	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	Boiler, steam condenser, Boiler mountings and accessories	Explain with chalk board initially. Also show the actual mountings and accessories mounted on their two wheelers.
	<b>CONCEPT</b>	Mechanism of formation of steam and its quality, condenser efficiency	Explain with chalk board initially. Discussing with the students their observations while heating the

		water and then using chalk board method
<b>PRINCIPLE</b>	Formation of steam, Isothermal and polytropic compression	Explain with chalk board initially. Discuss in detail with charts or model available in the laboratory.
<b>PROCEDURE</b>	Safety and procedure of improving boiler performance	Explain with chalk board initially. Show some related ppts or videos. Discuss case study in group at any thermal power station or the industry where boilers are used for steam formation.
<b>APPLICATION</b>	Applications of boiler and condenser	Explain with chalk board initially. Discuss the objectives of visit. Conduct the industrial visit at Government milk factory or thermal power station.

**Learning Resources:**

**Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
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

	<p><b>Teaching Aids:</b> Models, charts, Actual machines, power points.</p> <p><b>PPT with Sample:</b> Available on Google search. PPTS available at departmental library.</p> <p><b>Websites:</b> www.howstuffworks.com www.wikipedia.com www.watertubeboiler.org www.scince.uwaterloo.ca</p>
Lecture No.	Topic/ Subtopic to be covered
1	Formation of steam, various phases like wet steam, dry saturated steam, Superheated steam.
2	Dryness fraction, degree of superheat, sensible heat, Latent heat ,
3	calculation of enthalpy of wet, dry saturated and superheated steam Using Steam table.
4	Steam boilers: - construction and working of Three pass packaged type boiler
5	Steam boilers: - construction and working of La Mont Boiler
6	Steam condenser: - Function, locations in steam power plant.
7	Construction and working of two pass down flow Surface condenser.
8	Condenser efficiency and sources of air leakage in condenser
9	Review, practice, feedback and question bank

Topic 3	Name: <b>Air Compressors</b>		
	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	Reciprocating and rotary compressor, rock drill and pneumatic torque wrench.	Explain with chalk board initially. State some practical examples of compressed air. Like. Compressed air at petrol pumps service stations and road digging by rock drill etc.
	<b>CONCEPT</b>	compression	Explain with chalk board initially. Use related ppts and videos for better unstinting of concepts.
	<b>PRINCIPLE</b>	Isothermal, isentropic and polytropic compression	Explain with chalk board initially. Show some charts available at laboratory and discuss the

		principle.
<b>PROCEDURE</b>	Procedure of starting and operating the compressor	Explain with chalk board initially. Show the compressor in the laboratory and explain how to operate, ask them to handle and discuss among them.
<b>APPLICATION</b>	Applications of compressed air	Explain with chalk board initially. Also show the related ppts or videos of thermal power station.

**Learning Resources:**

**Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
1	R. S. Khurmi and J. K.Gupta	A Text book of Thermal Engineering	S. Chand and Co. Ltd.
2	A course in Thermal Engineering	S. Domkundwar, Dr C.P.Kothandaramanand A.V.Domkundwar	Dhanpat Rai and Co.(P)Ltd, New Delhi
3	Engineering Thermodynamics Work and Heat Transfer	Gordon Rogers Yon Mayhew	Pearson

**Teaching Aids:** Models, charts, Actual machine power points.

**PPT with Sample:** Available on Google search.

**Websites:**

www.howstuffworks.com  
www.wikipedia.com  
www.watertubeboiler.org  
[www.scince.uwaterloo.ca](http://www.scince.uwaterloo.ca)

Lecture No.	Topic/ Subtopic to be covered
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.
2	Construction and working of rotary compressors I) Centrifugal compressor
3	Construction and working of rotary compressors ii) Axial flow compressor
4	Construction and working of rotary compressors iii) Screw compressor, Comparison of various compressors
5	compressor terminology like i) Free air delivered ii) Capacity of Compressor, iii) Piston displacement, iv) I. P., v) B. P., vi) Volumetric efficiency
6	vii) Isothermal efficiency, viii) Overall Isothermal or Compressor efficiency. (Only definitions), Factors affecting volumetric Efficiency of reciprocating air compressors.
7	Applications of compressed air: construction and working of i) Rock drill, ii) pneumatic torque wrench.
8	Review,practice,feedback and question bank

Topic 4	Name: Gas Turbines		
	Knowledge Category	Example/s of category	Teaching methodology
	<b>FACT</b>	Steam turbines, Torque wrenches, Gas turbine, turbojet and turboprop engine	Explain with chalk board initially. Also show the cut off models, charts available in the laboratory
	<b>CONCEPT</b>	Formation of steam, open cycle and closed cycle gas turbine	Explain with chalk board initially. Explain the concept by giving practical examples.
	<b>PRINCIPLE</b>	Conversion of heat into work	Explain with chalk board initially. Discuss some practical example to understand the principle.
	<b>PROCEDURE</b>	Procedure of starting and operating operation of turbine. bleeding of turbine	Explain with chalk board initially. Show some related ppts. Videos to understand the procedure.
	<b>APPLICATION</b>	Thermal power stations	Explain with chalk board initially. Discuss the objectives of visit to thermal power plant. Arrange the visit to plant also conduct guest

lecture of guest lecture from thermal power station

**Learning Resources:**

**Books:**

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1	R. S. Khurmi and J. K.Gupta	A Text book of Thermal Engineering	S. Chand and Co. Ltd.
2	A course in Thermal Engineering	S. Domkundwar, Dr C.P. Kothandaramanand A.V.Domkundwar	Dhanpat Rai and Co.(P)Ltd, New Delhi
3	Engineering Thermodynamics Work and Heat Transfer	Gordon Rogers Yon Mayhew	Pearson
4	Govt. of India	Indian Boiler Act - 1923	

**Teaching Aids:** Models, charts, Actual machine power points.

**PPT with Sample:** Available on Google search.

**Websites:**

www.howstuffworks.com  
 www.wikipedia.com  
 www.watertubeboiler.org  
[www.scince.uwaterloo.ca](http://www.scince.uwaterloo.ca)

Lecture No.	Topic/ Subtopic to be covered
1	Brayton cycle - P.V. diagram and thermal efficiency. Classification of gas turbines.
2	Construction and working of gas turbines i) open cycle, ii)closed cycle.

3	Gas Turbines, P.V. and T.S diagrams.
4	Turbojet engine.
5	Turboprop engine.
6	Review, practice, feedback and question bank

Topic 5	<b>Name: Sources of Energy and Power plants</b>		
	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	Thermal power plant, Gas turbine power plant, Nuclear power plant, wind mill, solar collectors, solar heater	Explain with chalk board initially. Discuss the topic among student by assigning the seminar topics to the students in groups. Ask them to prepare ppts. and present in the class room with question answer session under the guidance of teacher.
	<b>CONCEPT</b>	Conservation of energy resources	Explain with chalk board initially. Explain the concept by giving more examples form real life/ practical field.
	<b>PRINCIPLE</b>	Renewable and non renewable energy sources	Explain with chalk board initially. For better understanding conduct group discussion or presentation under the guidance of subject teacher.
	<b>PROCEDURE</b>	Procedure of assembling and disassembling of devices	Explain with chalk board initially. Conduct exercise of assembly/ disassembly by actual exercise or practice in the laboratory.
<b>APPLICATION</b>	Various ways to harness different sources of energy	Explain with chalk board initially. Discuss the issue of harnessing the energy by conducting brainstorming among the students.	

Also allot a mini-project in related areas.

**Learning Resources:**

**Books:**

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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, III )	Acharya Book Depot.
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4	Govt. of India	Indian Boiler Act - 1923	

**Teaching Aids:** Models, charts, Actual machine power points.

**PPT with Sample:** Available on Google search. And ppts available with respective teacher.

**Websites:**

www.howstuffworks.com  
 www.wikipedia.com  
 www.watertubeboiler.org  
 www.scince.uwaterloo.ca

Lecture No.	Topic/ Subtopic to be covered
1	Classification of various conventional and non-conventional sources of Energy. Construction and working of power plants based on conventional energy sources like :
2	a) Thermal power plant.
3	b) Gas turbine power plant c) Nuclear power plant -Pressurized water reactor. Parameters for the site selection of conventional power plants.
4	Power plants based on non-conventional energy sources.

	i) Solar
5	ii) Biomass
6	iii) Wind energy
7	Concepts of Geothermal and tidal power plant.
8	Review,practice,feedback and question bank

Topic 6	<b>Name: Fuels and Combustion.</b>	
	<b>Knowledge Category</b>	<b>Example/s of category</b>
	<b>FACT</b>	Calorific value measuring devices
	<b>CONCEPT</b>	Calorific value of fuels and chemistry of combustion
	<b>PRINCIPLE</b>	Chemistry of combustion of fuels calorific value of fuels evaporative power of fuels.
	<b>PROCEDURE</b>	Calculate H.C.V,L.C.V. of fuel, procedure of starting and Operating of Bomb calorimeter
	<b>APPLICATION</b>	Calorific value measuring devices, flue gas analyzer
	<b>Teaching methodology</b>	
		Explain with chalk board initially. Perform some experiments in laboratory for reinforcing the knowledge of facts.
		Explain with chalk board initially. Solve elementary numerical for better understanding of concept.
		Explain with chalk board initially. Discuss the need and importance of these principles and its applications.
		Explain with chalk board initially. Use simple numerical to explain the calculation part, conducting an experiment at laboratory
		Showing the apparatus at laboratory and tell them to handle.
	<b>Learning Resources:</b>	
	<b>Books:</b>	

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	Engineering Thermodynamics	Jones and Dugan	Prentice hall of India Publication.
3	Thermodynamics	Yunus Cegeland Mike Boles	Tata McGraw Hill Publication
4	Engineering Thermodynamics Work and Heat Transfer	Gordon Rogers Yon Mayhew	Pearson
5	Govt. of India	Indian Boiler Act - 1923	

**Teaching Aids:** Models, charts, Actual machine power points.

**PPT with Sample:** Available on Google search.

**Websites:**

www.howstuffworks.com

www.wikipedia.com

www.watertubeboiler.org

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

Lecture No.	Topic/ Subtopic to be covered
1	Types of fuels – Definition, classification, properties, Calorific value of fuels
2	Ultimate analysis and proximate analysis of solid fuels.
3	Liquid fuels- Comparative information about composition, specific Gravity and gross calorific values of liquid fuel.
4	Gaseous fuels- natural, LPG, CNG, and other artificially prepared Gaseous fuels.
5	Higher and lower Calorific values of fuel and it's estimation, carbon Value, evaporative power of fuel.
6	Dulong's formula, construction and Working of Bomb calorimeter.
7	Combustion of fuels – combustion chemistry of carbon, hydrogen and

	Methane. Mass of air required for complete combustion of fuel, excess Air.
8	Review,practice,feedback and question bank

## 5.2 Planning and Conduct of Test:

- a) The time table and sample test paper for the test should be displayed minimum 10 days before the test.
- b) Each test will be of 25 marks.
- c) First test should cover about 40% of curriculum and second test should cover remaining curriculum.
- d) Format for question paper should be as per the sample question paper supplied by MSBTE.
- e) Guidelines for Setting Class Test Question Paper:
  - Question no.1 Attempt any three out of four (3X3=9 Marks)
  - Question no.2 Attempt any two out of three (2X4=8 Marks)
  - Question no.3 Attempt any two out of three (2X4=8 Marks)

## 5.4 Strategies for Conduct of Practical:

- The practicals shall be carried out exactly as mentioned in the syllabus as far as possible.
- Industrial visit shall be carried out as far as possible. If concerned industry / foundry are not located in the nearby area then at least video clips which are available on various website shall be shown to the students. ( This should be the last choice not the first one)

### 5.4.1 Suggestions for effective conduct of practical and assessment:

- Additional assignments / extra practical for better motor skill can be done so as to enhance the knowledge of student.
- Any other related practice / work / job / can be done as an additional assignment  
Use Lab manual.

## **6. Mode of assessment:**

### 1.1 Class Test:

- There will be two tests each of 25 marks.
- The tests will be conducted as per the MSBTE schedule.
- Teacher should prepare model answer of class test question papers.
- After completion of test, subject teacher should display model answer on Department Notice Board.
- Teacher should show the answer paper of class test to the student and discuss about the mistakes.
- Teacher should maintain the record of class test as per MSBTE norms (CIAAN)

6.1.2 Sample Test Papers:

**Sample Test Paper I**

<b>Roll No.</b>				
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17407

Institute Name:

**Course Name:** Automobile engineering

**Course Code:** AE

**Semester:** Fourth

**Subject:** Heat Power Engineering (17407)

**Marks:** 25

**Time:** 1 hour

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**Instructions:**

1. All questions are compulsory
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks
4. Assume suitable data if necessary
5. Preferably, write the answers in sequential order

**Q1. Attempt any three (3x3=9)**

- a) Represent isobaric and isochoric, isothermal and adiabatic process on P-V and T-S diagram.
- b) Define i. free air delivered  
ii. Compressor capacity iii.piston displacement iv.Indicated power.
- c). Write the construction and working of two pass down flow surface condenser.
- d). Explain the sources of air leakage in condenser(any three)
- e). Write the classification of air compressor

**Q2. Attempt any two (2x4=8)**

- a). Describe the different phases of formation of steam.
- b). State different modes of heat transfer, explain anyone in detail.
- c). State the applications of compressed air.(minimum four).

**Q3. Attempt any two (2x4=8)**

- A). What is the necessity of multistage and intercooling in air compressor.
- b). Explain the construction and working of three pass packaged type boiler.
- c). Derive the relation between P, V and T during adiabatic process

6.1.2 Sample Test Papers:

**Sample Test Paper II**

<b>Roll No.</b>				
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17407
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Institute Name:

**Course Name:** Automobile engineering

**Course Code:** AE

**Semester:** Fourth

**Subject:** Heat Power Engineering (17407)

**Marks:** 25

**Time:** 1 hour

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**Instructions:**

1. All questions are compulsory
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks
4. Assume suitable data if necessary
5. Preferably, write the answers in sequential order

**Q1. Attempt any three (3x3=9)**

- a) List the properties of fuel.
- b).Give the classification of fuels.
- c). Explain Turbojet engine.
- d) .Identify the application of gas turbine in aviation industries.
- e). Define ultimate analysis and proximate analysis of coal

**Q2. Attempt any two (2x4=8)**

- a) Explain Brayton cycle with P-V and T-S diagram.
- b). Demonstrate the construction and working of open cycle gas turbine.
- c).Differentiate between open cycle and closed cycle gas turbine with its schematic diagram

**Q3. Attempt any two (2x4=8)**

- a).Explain the construction and working of two stage reciprocating air compressor.
- b). Explain the working of Tidal plant with the help of neat sketch.
- c).Explain the construction and working of Bomb Calorimeter.

6.2.1 Specification Table:

**Course Name:** Automobile Engineering

**Course Code:** AE

**Semester:** Fourth

**Title of the Subject:** Heat Power Engineering

**Subject Code:** 17407

**SPECIFICATION TABLE**

Level Chapter /Topic	Levels from Cognition Process Dimension			Total Marks
	R	U	A	
<b>1</b>	<b>5(3)</b>	<b>8(2)</b>	<b>5(3)</b>	<b>18(8)</b>
<b>2.1</b>	<b>4(3)</b>			<b>4(3)</b>
<b>2.2</b>		<b>4(3)</b>	<b>4</b>	<b>8(3)</b>
<b>2.3</b>	<b>2(3)</b>	<b>4</b>		<b>6(3)</b>
<b>3</b>	<b>8(3)</b>	<b>5(3)</b>	<b>5(3)</b>	<b>18(9)</b>
<b>4.1</b>	<b>2</b>	<b>2(3)</b>		<b>4(3)</b>
<b>4.2</b>	<b>4</b>	<b>3(4)</b>	<b>3</b>	<b>10(4)</b>
<b>5</b>	<b>5(3)</b>	<b>5(2)</b>	<b>6(2)</b>	<b>16(7)</b>
<b>6.1</b>	<b>4(2)</b>			<b>4(2)</b>
<b>6.2</b>	<b>2</b>	<b>4</b>	<b>2(4)</b>	<b>8(4)</b>
<b>6.3</b>			<b>4(2)</b>	<b>4(2)</b>
<b>TOTAL</b>	<b>36(17)</b>	<b>35(17)</b>	<b>29(14)</b>	<b>100 (48)</b>

Remember

U – Understand

A–Analyse/Apply

6. 2.2 QUESTION PAPER PROFILE:

**Course Name:** Automobile Engineering  
**Semester:** Fourth  
**Title of the Subject:** Heat power engineering

**Course Code:** AE

**subject Code:** 17407

Q. No	Bit 1			Bit 2			Bit 3			Bit 4			Bit 5			Bit 6			Bit 7			Bit 8			Optional
	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	T	L	M	
01 a	1	R	2		R	2	3.1	R	2	3.1	R	2	4.1	U	2	5.1	U	2	6.1	U	2	6.1	R	2	6/8
01 b	1	A	4	2	R	4	4.1	U	4																2/3
02	1	A	4	1	U	4	2.2	U	4	2.2	U	4	3.2	R	4	4.2	A	4							4/6
03	3	U	4	4	U	4	5.1	U	4	5.1	R	4	6.1	R	4	6.1	A	4							4/6
04	5	U	8	6.1	R	8	5.1	U	4	6.1	U	4													2/3
05	1	A	8	2.1	U	8	3.1	A/R	8																2/3
06	1	A	4	2.1	A	4	3.1	R	4	3.1	U	4	4.1	U	4	4.1	U	4							6/8

T = Topic/Chapter Number  
 U = Understand

L = Level of Question  
 A = Analyse/Apply

M = Marks  
 R = Remember

6.2.3 Sample Question Paper:

<b>Exam Seat No.</b>									
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17407
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Maharashtra State Board of Technical Education

**Course Name:** Diploma in Automobile Engineering

**Course Code:** AE

**Semester:** Fourth

**Title of the Subject:** Heat Power Engineering

**Subject Code:** 17407

**Marks:** 100

**Time:** 03 Hours

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**Instructions:**

1. *All questions are compulsory*
2. *Illustrate your answers with neat sketches wherever necessary*
3. *Figures to the right indicate full marks*
4. *Assume suitable data if necessary*
5. *Preferably, write the answers in sequential order*

**Q1.A. Attempt any six**

**(6 x 2)**

- a).State different types of ideal gas processes.(Any four)
- b).Define dryness fraction and degree of superheat.
- c).Define volumetric efficiency and isothermal efficiency of air compressor.
- d).State the applications of compressed air.
- e).Give the classification of gas turbine on the basis of working principle.
- f).Give the classification of conventional and non conventional sources of energy.
- g).List the properties of fuel. (Any four)
- h).Define Fuel and state the type of Fuel.

**Q1.B Attempt any two**

**(2x 4)**

- a).Represent isobaric and isochoric, isothermal and adiabatic process on P-V and T-S diagram.
- b).Describe the different phases of formation of steam.
- c).Explain with neat sketch principle and working of Turbojet engine.

**Q2. Attempt any four****(4x4)**

- a). Represent the Carnot and Otto cycle on P-V and T-S diagram and write equation for air standard efficiency of the same.
- b). Explain the different modes of heat transfer.
- c). Draw neat and labeled sketch of La-mont Boiler.
- d). Explain the construction and working of three pass packaged type boiler
- e). Define i. Free air delivered ii. compressor capacity iii. piston displacement iv. Indicated power.
- f). Identify the application of gas turbine in aviation industries

**Q3. Attempt any four****(4x4)**

- a). Write the classification of air compressor. (any four)
- b). Explain Brayton cycle with P-V and T-S diagram.
- c). What do you understand by non conventional power generation system? Explain their importance in the present situation of power shortage throughout the world.
- d). Write a short note on nuclear power plant.
- e). Define ultimate analysis and proximate analysis of coal, Explain how sampling of coal is done in boiler trial
- f). A coal has the following composition by mass C=90%, H<sub>2</sub>=3%, S=1%, O<sub>2</sub>=2%, N<sub>2</sub>=2% and remaining is ash find the HCV and LCV of the fuel.

**Q4. Attempt any two****(2 x 8)**

- a). Draw a neat line diagram of a thermal power plant component and explain their working with the help of cycle on which it works.
- b). Define calorific value of the fuel, Differentiate between HCV and LCV of the fuel and state which value is used in calculation and why.
- c). Attempt the following
  - I. Explain the working of Tidal plant with the help of neat sketch.
  - II. Explain the construction and working of Bomb Calorimeter.

**Q.5. Attempt any two****(2x8)**

- a). Derive the relation between P, V and T during adiabatic process
- b). With the help of neat sketch Explain the construction and working of two pass down flow surface condenser and state its specific applications.

c). Explain the construction and working of axial flow compressor. Differentiate between reciprocating and rotary air compressor.

**Q 6. Attempt any four**

**(4x4)**

- a).State the air standard efficiency of diesel and dual combustion cycle.
- b).Explain the sources of air leakage in condenser
- c).What is the necessity of multistage and intercooling
- d).Demonstrate the construction and working of open cycle gas turbine.
- e).Differentiate between open cycle and closed cycle gas turbine with its schematic diagram
- f).Explain the construction and working of two stage reciprocating air compressor

Submitted by: 1).Monali Deepak Kothekar (Bhojane), Govt. Poly.Nagpur

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