

# **CURRICULUM REVISION PROJECT**

**2012**

**TEACHER GUIDE FOR**

(Thermal Engineering -17410)

**FOURTH SEMESTER MECHANICAL 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.

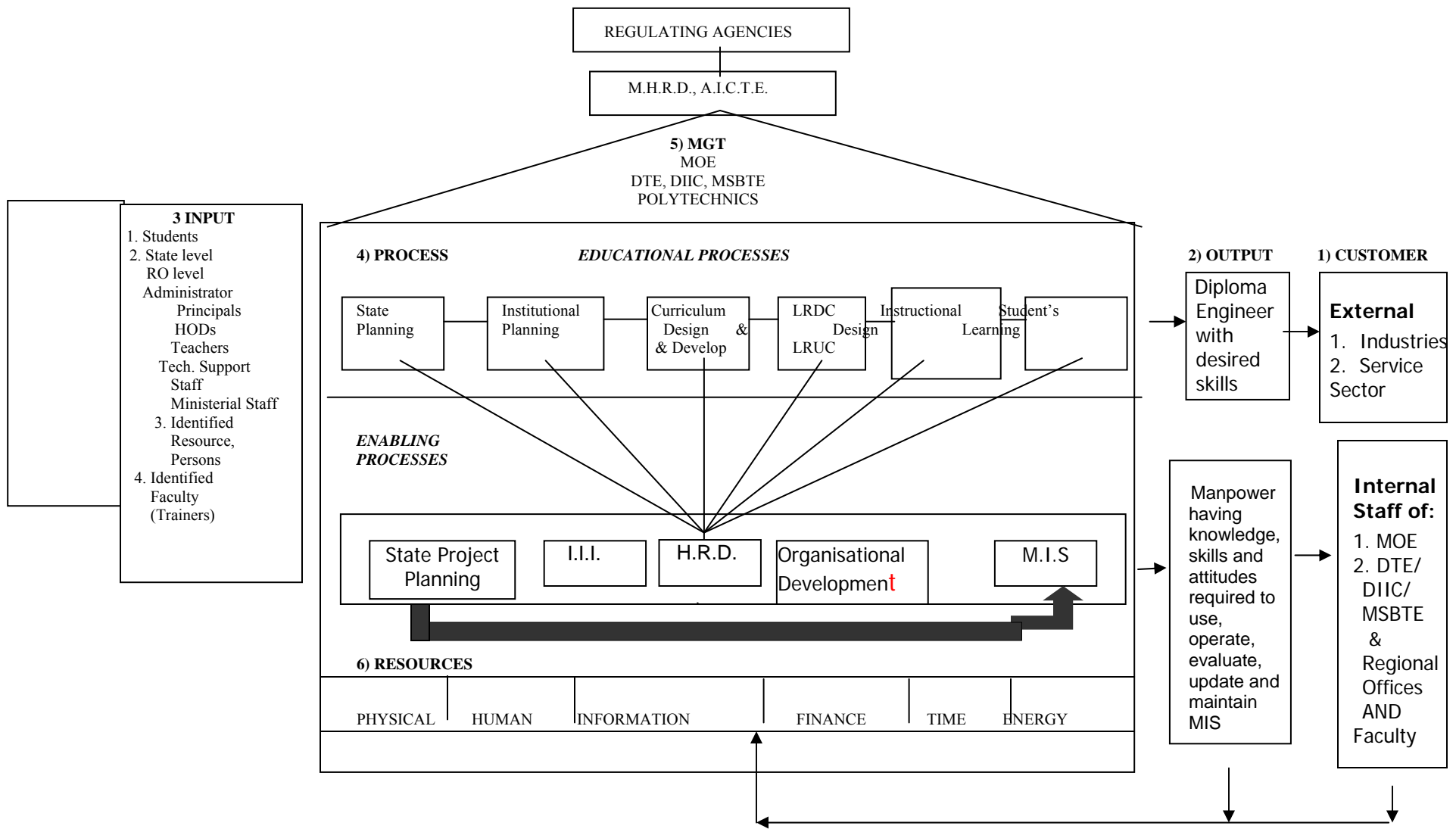
To fulfill the needs derived from systems approach following conceptual framework is considered:

## 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 intellectual and motor skills in order to satisfactorily perform duties assigned to them:

##### **A) Intellectual skills.**

- 1) Read and interpret Civil Engineering drawings.

- 2) Prepare estimates and bill of quantities.
- 3) Carryout Civil engineering survey.
- 4) Design simple civil engineering structures.
- 5) Prepare tender documents.
- 6) Plan, execution of various construction activities.
- 7) Test engineering materials, prepare reports and interpret them.
- 8) Use various civil engineering software.
- 9) Follow various standards and codes.
- 10) Maintain records in various formats.
- 11) Carry out building maintenance.
- 12) Prepare various building plans as per requirements by using appropriate byelaws.
- 13) Supervise construction work.
- 14) Select appropriate technique for quality control.

**B) Motor Skills.**

- 1) Prepare manual and Computer generated Civil engineering drawings.
- 2) Use survey instruments, plot survey data and prepare drawings.
- 3) Handle testing of equipments.
- 4) Lay out of Civil engineering structures.
- 5) Draw free hand sketches of Civil engineering structures.

**1.6 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 Applied 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 Studies 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 at the sixth semester 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 Civil Engineering Group CAD and Building Materials have been added as an independent subject. Topics on Airport Engineering and Docks and Harbours have been added in the subject Transportation Engineering.

## **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:**

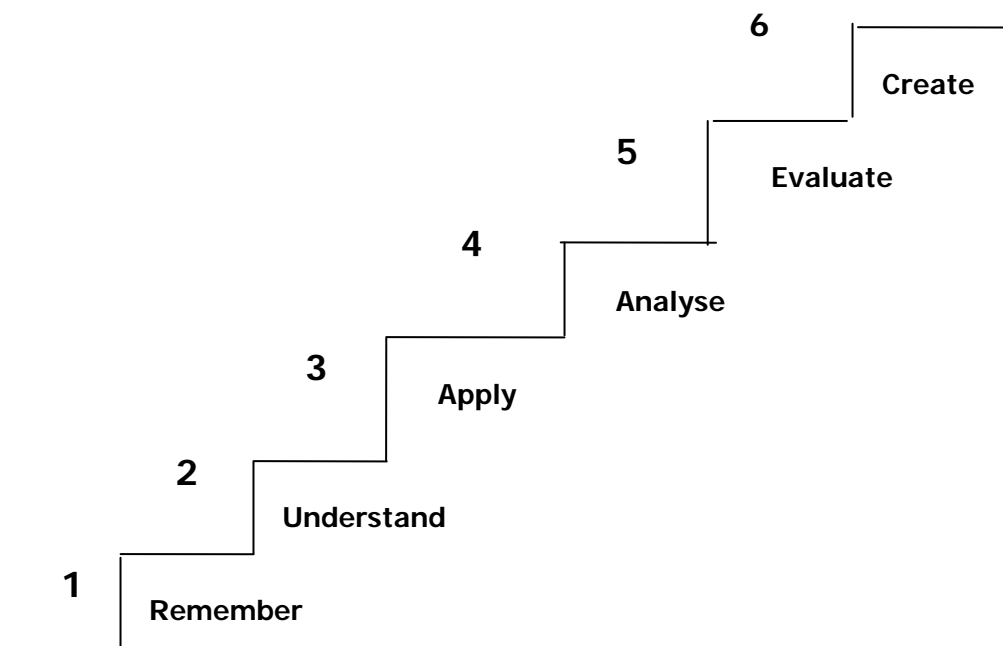
Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for

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 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.	Understands fact, principles Interprets verbal material, Interprets charts, tables, graphs. Translates verbal material to mathematical formula. Estimates consequences implied in data. Justifies methods & procedures.	Convert, distinguish estimate, explain, 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.	Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/	Breakdown, diagram, differentiate, discriminate, distinguish, identify illustrate, infer, outline,

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.	adequacy of data.	point out, relate, select, separate, subdivide.
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### 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 the entire curriculum.

Rationale tells the students the connection of subjects related to the 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 gives 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:** 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.

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

### **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 other 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 Mechanical Engineering**

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

**Semester : Fourth**

**Subject Title : Thermal Engineering**

**Subject Code : 17410**

#### **Teaching and Examination Scheme:**

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

#### **NOTE:**

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

#### **Rationale:**

Mechanical Engineers have to work with various power producing & power absorbing devices like Boilers, Turbines, Compressor, I.C. Engines, and Pumps etc. In order to understand the principles, construction and working of the devices, it is essential to understand the concept of energy, work, heat and conversion between them.

The subject is related to Power Engineering and other related subjects in which the application of fundamental concepts of Thermal Engineering are included.

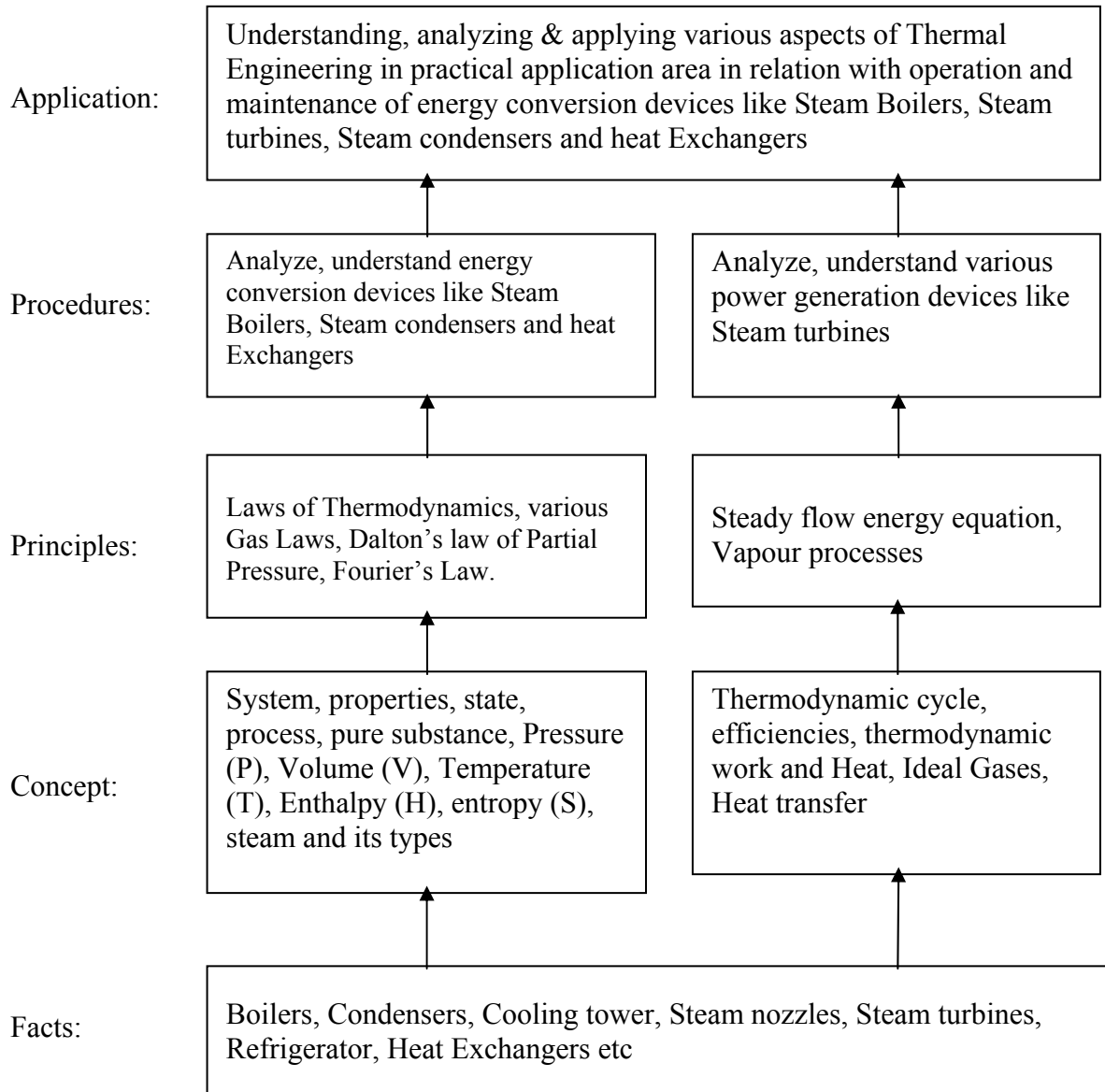
#### **General Objectives:**

The Student will be able to:

1. Define fundamental concepts of thermodynamics to thermodynamic systems.
2. Use various laws of thermodynamics.
3. Apply various gas laws and ideal gas processes to various thermodynamic systems.
4. Draw the construction and explain working of boilers, turbines & condensers.

5. Find properties of two phase system from steam table / mollier charts
6. State the various modes of heat transfer.

## Learning Structure:



**Theory Content:**

Topic and Contents	Hours	Marks
<p><b>1. Fundamentals of Thermodynamics -----20 Marks</b>  <b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Define fundamental concepts of Thermodynamics</li> <li>➤ Apply first law of thermodynamics to various thermodynamic devices.</li> <li>➤ Apply second law of thermodynamic.</li> </ul> <p>Contents</p> <p>1.1 Concepts of pure substance, types of systems , properties of systems- Extensive and Intensive properties, processes and cycles, Quasi-static process, flow and non flow process, Thermodynamic equilibrium, Point and path function. <b>04 Marks</b></p> <p>1.2 Work, Heat Transfer and Energy. Thermodynamic definition of work &amp; heat, Difference between heat and work. Energy –Potential Energy, Kinetic Energy, Internal Energy, Flow Work, concepts of enthalpy &amp; entropy. <b>04 Marks</b></p> <p>1.3 Laws of Thermodynamics- Zeroth Law, principle of law of conservation of energy First law of Thermodynamics, Second Law of Thermodynamics- Kelvin Planks, Clausius statements and their equivalence, Clausius inequality, Concept of perpetual motion machine of first and second kind. <b>06 Marks</b></p> <p>1.4 Application of Laws of Thermodynamic:- Steady Flow Energy equation and its application to boilers, engine, nozzle, turbine, compressor &amp; condenser. Application of Second law of Thermodynamics to Heat Engine, Heat Pump and Refrigerator. <b>06 Marks</b></p>	12	20
<p><b>2. Ideal Gases -----12 Marks</b>  <b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ State ideal gas laws</li> <li>➤ Represent various ideal gas processes on P-V and T-S diagrams</li> </ul> <p>Contents</p> <p>2.1 Concept of Ideal gas- Charle’s law, Boyle’s law, Avogadro’s law, equation of state, characteristic gas constant and universal gas constant. <b>04 Marks</b></p> <p>2.2 Ideal gas processes: -          Isobaric, Isochoric, Isothermal, Isentropic, Polytropic, and their representation on P-V and T-S diagram (only simple numerical based on above) <b>08 Marks</b></p>	08	12
<p><b>3. Steam and Steam Boiler -----20 Marks</b>  <b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ State the concept of Steam generation.</li> <li>➤ Use of steam tables and Mollier chart.</li> <li>➤ Explain construction and working of different types of boilers and</li> </ul>	12	20

<p>function of mountings &amp; accessories</p> <p>Contents</p> <p>3.1 Generation of steam at constant pressure with representation on various charts such as T-S, H-S. Properties of steam and use of steam table, Dryness fraction, Degree of superheat <b>04 Marks</b></p> <p>3.2 Vapour processes :- Constant pressure, constant volume, constant enthalpy, constant entropy process (numerical using Mollier chart), Rankine Cycle. <b>06 Marks</b></p> <p>3.3 Steam Boilers: - Classification, Construction and working of - Cochran, Babcock and Wilcox, La-mont and Loeffler boiler. Boiler draught. Indian Boiler Regulation (IBR) <b>06 Marks</b></p> <p>3.4 Boiler mountings and accessories (to be covered in practical periods). <b>04 Marks</b></p>		
<p><b>4. Steam Nozzles and Turbines -----16 Marks</b></p> <p><b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Define Mach number &amp; critical pressure.</li> <li>➤ State the application of steam nozzles.</li> <li>➤ Explain the principle of working of steam turbine</li> </ul> <p>Contents</p> <p>4.1 Steam nozzle: - Continuity equation, types of nozzles, concept of Mach number, critical pressure, application of steam nozzles. <b>04 Marks</b></p> <p>4.2 Steam turbine: - Classification of turbines, Construction and working of Impulse and Reaction turbine. <b>06 Marks</b></p> <p>4.3 Compounding of turbines and its types, Regenerative feed heating, bleeding of steam, governing &amp; its types, losses in steam turbines (no velocity diagrams and numerical). <b>06 Marks</b></p>	10	16
<p><b>5. Steam Condensers and Cooling Towers -----16 Marks</b></p> <p><b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Apply Dalton's law to condenser.</li> <li>➤ Explain construction and working of condensers and cooling towers.</li> <li>➤ State the effect of air leakages in condenser</li> </ul> <p>Contents</p> <p>5.1 Dalton's law of partial pressure, function and classification of condensers, construction and working of surface condensers. <b>04 Marks</b></p> <p>5.2 Sources of air leakage and its effect, concept of condenser efficiency, vacuum efficiency (Simple numerical). <b>06 Marks</b></p> <p>5.3 Cooling Towers.-Construction and working of forced, natural and induced draught cooling tower. <b>06 Marks</b></p>	12	16
<p><b>6. Heat Transfer -----16 Marks</b></p> <p><b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Describe various modes of heat transfer.</li> <li>➤ Describe construction and working of different types of Heat exchangers.</li> </ul> <p>Contents</p>	10	16

6.1	Modes of heat transfer: - Conduction, convection and radiation. Conduction :- <b>08 Marks</b> Fourier's law, thermal conductivity, conduction through cylinder, thermal resistance, composite walls (Simple numerical) <b>04 Marks</b>		
6.2	Radiation:- Thermal Radiation, Absorptivity, Transmissivity, Reflectivity, Emissivity, black and gray bodies, Stefan-Boltzman law. <b>04 Marks</b>		
6.3	Heat Exchangers: - Classification, Construction and working of Shell and tube, shell and coil and pipe in pipe type, plate type heat exchanger and its applications.		
<b>Total</b>		<b>64</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. **Explain** various concepts and fundamentals of thermodynamics.
2. **Explain** vapour processes, principle of working of steam boilers and function of different mountings and accessories.
3. **Draw** construction and **explain** working of steam turbines and condensers.
4. **State the various** modes of heat transfer and concept of heat exchanges.
5. Interpret steam tables, Mollier chart and relationship between different thermodynamic properties.
6. **List** different sources of energy and their applications

**Motor Skills:**

1. Trace path of flue gases and water steam circuit in a boiler.
2. Collect information and write report on boiler and its mounting and accessories.
3. Conduct trial on the setup for calculation of thermal conductivity of metal rod.
4. Collect information and write technical specifications of photovoltaic cells and identify different components on panels of photovoltaic cells.
5. Report writing on presentation given on Renewable sources of energy.

**List of Practicals:**

1. Trace and draw the path of Flue Gases and Water Steam circuit with the help of models of 'Babcock & Wilcox' and 'La-Mont' Boiler or any other similar model available in the laboratory.
2. Draw and understand working of various types of Boiler Mountings and Accessories.
3. Prepare a report on visit to Sugar Factory / Steam Power Plant / Dairy industry with specification of boiler and list of mountings and accessories along with their functions.

4. Draw the sketches of impulse and reaction turbines; describe their working and differences through a cut section model or a working model. Focus should be on the use for electrical power generation.
5. Draw a Neat sketch and understand working of Jet Condenser. Component must be labeled. State function of components and material used.
6. Calculate the thermal conductivity for a given sample of solid metallic rod.
7. Classify heat exchangers and write their descriptions. Observe the various heat exchangers available in laboratory with their specifications.
8. Mini project: Student will prepare individually a report on Renewable sources of energy and make power point presentation on the following.
  - a) Solar water heating system
  - b) Photo voltaic cells
  - c) Bio gas, Bio mass and Bio Diesel as a fuel
  - d) Wind, Tidal and Geothermal Energy

**[Assignments to be completed in a group of (max.) four students. The topics should be distributed in the groups.]**

**Learning resources:**

**Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
1	Domkundwar V. M.	A Course in Thermal Engineering	Dhanpat Rai & Co.
2	R. S. Khurmi	A text book of Thermal Engineering.	S. Chand & Co. Ltd.
3	P. Chattopadhyay	Engineering Thermodynamics	Oxford University Press
4	P. K. Nag	Engineering Thermodynamics	Tata McGraw - Hill, New Delhi
5	B. K. Sarkar	Thermal Engineering	Tata McGraw - Hill, New Delhi
6	P. L. Ballaney	A Course in Thermal Engineering	Khanna Publishers
7	R. K. Rajput	A Course in Thermal Engineering	Laxmi Publication, Delhi

## 5. IMPLEMENTATION STRATEGY:

### 5.1 Planning of Lectures for a Semester with Content Detailing:

<b>Topic 1</b>	<b>Name: Fundamentals of Thermodynamics.</b>		
	<p><b>Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.</b></p>		
	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	Boiler, Condenser, Cooling Tower, Steam Nozzle, Steam Turbine, Refrigeration, Heat Exchanger.	Chalk & Black Board PPT Models Charts
	<b>CONCEPT</b>	System, Properties, State, Process, Pure Substance, pressure, temperature, volume, enthalpy, Entropy.	Chalk & Black Board PPT
	<b>PRINCIPLE</b>	Laws of Thermodynamic	Chalk & Black Board PPT
	<b>PROCEDURE</b>	Understand Types of energy & it's Conversion	Chalk & Black Board PPT
<b>APPLICATION</b>	Application of Various devices Like, Boiler, Steam Turbine, Condenser, Nozzles etc.	Black Board.	
<p>Learning Resources: Model, Chart, PPT            Books:            Title: 1) Course in Thermal Engineering by R.K.Rajput            2) Course in Thermal Engineering by P.L.Ballaney            3) Thermal Engineering by B.K.Sakar</p>			
<p>Teaching Aids: Black Board &amp; Chocks ,PPT, Model Chart</p>			

Lecture No.	Fundamentals of Thermodynamics.
1	Concepts of pure substance, types of systems.
2	Properties of systems- Extensive and Intensive properties.
3	Processes and cycles, Quasi-static process, flow and non flow process
4	Thermodynamic Equilibrium, Point and path function
5	Work, Heat, and Energy, Difference between heat and work
6	Energy –Potential Energy, Kinetic Energy, Internal Energy, Flow Work, concepts of enthalpy & entropy.
7	Laws of Thermodynamics- Zeroth Law, principle and law of conservation of energy, First law of Thermodynamics
8	Second Law of Thermodynamics- Kelvin Planks, Clausius statements and their equivalence
9	Clausius inequality, Concept of perpetual motion machine of first and second kind.
10	Application of laws of thermodynamics:- steady flow energy equation and its application to boiler, engine
11	Application of laws of thermodynamics:- steady flow energy equation and its application to nozzle, turbine ,compressor and condenser.
12	Application of second laws of thermodynamics to Heat engine and Refrigerator.

**Topic 2****Name: Ideal Gases.**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.

Knowledge Category	Example/s of category	Teaching methodology
<b>FACT</b>	Air,vapour.gases etc.	Black board ppt
<b>CONCEPT</b>	Pressure,temperature,volume Workdone,heat,enthalpy, Entropy Thermodynamics heat and work, internal energy, ideal gas	Black board and ppt
<b>PRINCIPLE</b>	Various gas laws and relations	Black board ppt
<b>PROCEDURE</b>	Relation between pressure,temperature,volume, Specific heat at constant pressure and volume	ppt
<b>APPLICATION</b>	To determine pressure,temperature,volume	ppt

Learning Resources: Model, Chart, PPT

Books:

- Title: 1) Course in Thermal Engineering by R.K.Rajput  
2) Course in Thermal Engineering by P.L.Ballaney  
3) Thermal Engineering by B.K.Sakar

Teaching Aids: Black Board & Chocks ,PPT, Model Chart

PPTs: [www.slideshare.net](http://www.slideshare.net)

Websites [www.slideshare.net](http://www.slideshare.net)

Lecture No.	Ideal Gases
1	Charles's law, Boyle's law, Avogadro's law,
2	Equation of state, Characteristic gas constant and universal gas constant.
3	Isobaric Process and Isochoric Process
4	Isothermal Process and Isentropic Process
5	Polytropic Process, Difference between above processes.
6	Simple Numerical on Isobaric Process and Isochoric Process
7	Simple Numerical on Isothermal Process and Isentropic Process
8	Representation of above processes on P-V and T-S diagram

<b>Topic 3</b>	<b>Name: Steam and Steam Boiler.</b>		
	<p><b>Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.</b></p>		
	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	Types of Boiler, Steam Generation and Vapour Process	PPT Model
	<b>CONCEPT</b>	Indian Boiler regulation Model Chart, Steam Table	PPT
	<b>PRINCIPLE</b>	Vapour Processes	Black Board
	<b>PROCEDURE</b>	Understand Energy Conversion devices like Boiler	Black Board
<b>APPLICATION</b>	Energy Conversion device like Boiler	PPT	
Learning Resources: Model, Chart, PPT			

	<p>Books:  Title: 1) Course in Thermal Engineering by R.K.Rajput  2) Course in Thermal Engineering by P.L.Ballaney  3) Thermal Engineering by B.K.Sakar</p> <p>Teaching Aids: Black Board &amp; Chocks ,PPT, Model Chart</p> <p>PPTs: <a href="http://www.slideshare.net">www.slideshare.net</a></p> <p>Websites <a href="http://www.slideshare.net">www.slideshare.net</a></p>
Lecture No.	Steam and Steam Boiler
1	Generation of steam at constant pressure with representation on various charts such as T-S, H-S
2	Properties of steam and use of steam table, Dryness fraction, Degree of superheat
3	Vapour Processes :-Constant pressure, constant volume
4	Constant enthalpy, constant entropy process
5	(Numerical using Mollier chart & steam table), Rankine Cycle, Dryness Fraction
6	(Numerical using Mollier chart& steam table), Rankine Cycle, Dryness Fraction
7	Steam Boilers: - Classification, Difference between water tube boiler and fire tube boiler.
8	Construction and working of Cochran Boiler and Babcock & Wilcox Boiler
9	Construction and working of La-mont Boiler and Loeffler Boiler.
10	Boiler Draught. Indian Boiler Regulation (IBR)
11	Boiler mountings and its various types
12	Boiler Accessories and its various types

**Topic 4****Name: Steam Nozzles & Turbines**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.

Knowledge Category	Example/s of category	Teaching methodology
<b>FACT</b>	Types & Application of Nozzle & Turbine	Black Board PPT
<b>CONCEPT</b>	Pressure, Temperature, Volume, Enthalpy, Entropy, Steam mach no., Critical Pressure	Black Board PPT
<b>PRINCIPLE</b>	Principle of Working of Steam Turbine, Continuity equation	Black Board PPT
<b>PROCEDURE</b>	Understand Various Power generation device like steam turbines	Models Charts PPT
<b>APPLICATION</b>	Understanding, analyzing & applying Various aspects to nozzles of turbines	

Learning Resources: Model, Chart, PPT

Books:

- Title: 1) Course in Thermal Engineering by R.K.Rajput  
 2) Course in Thermal Engineering by P.L.Ballaney  
 3) Thermal Engineering by B.K.Sakar

Teaching Aids: Black Board & Chocks ,PPT, Model Chart

PPTs: [www.slideshare.net](http://www.slideshare.net)

Websites:- [www.slideshare.net](http://www.slideshare.net)

Lecture No.	Steam Nozzles & Turbines.
1	Continuity equation, types of nozzles, concept of Mach number,
2	Critical pressure, application of steam nozzles,
3	Classification of turbines, Construction and working of Impulse Turbine
4	Construction and working of Reaction turbine.
5	Pressure Compounding of turbines
6	Velocity Compounding of turbines
7	Combined Pressure & Velocity Compounding of turbines
8	Bleeding of steam and Regenerative feed heating
9	Governing & its types,
10	Losses in steam turbines

**Topic 5****Name: Steam Condensers and Cooling Tower**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.

<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
<b>FACT</b>	Types and Function of condenser & cooling Tower	Models PPT
<b>CONCEPT</b>	Utility of condenser & cooling Tower in Thermal Power Plant	Charts PPT
<b>PRINCIPLE</b>	Dalton's Law of Partial Pressure	Black.Board PPT
<b>PROCEDURE</b>	Analyze & Understand energy Conversion in Steam Condenser.	PPT Black.Board
<b>APPLICATION</b>	Operation & Maintenance of steam condenser & cooling Tower	Use Model Visit to Thermal Power Plant.

Learning Resources: Model, Chart, PPT

Books:

- Title: 1) Course in Thermal Engineering by R.K.Rajput  
 2) Course in Thermal Engineering by P.L.Ballaney  
 3) Thermal Engineering by B.K.Sakar

Teaching Aids: Black Board, PPT

Websites [www.slideshare.net](http://www.slideshare.net)

Lecture No.	Steam Condensers and Cooling Tower
1	Dalton's law of partial pressure and its application
2	Classification of condensers
3	Construction and working of surface condenser
4	Use and function of condenser
5	Sources of air leakage in condenser and its effect
6	Concept of condenser efficiency, vacuum efficiency.
7	Simple numerical on condenser to reinforce the concept
8	Simple numerical on condenser to reinforce the concept
9	Introduction to cooling towers and its types
10	Construction and working of forced draught cooling tower.
11	Construction and working of natural draught cooling tower.
12	Construction and working of induced draught cooling tower

**Topic 6****Name: Heat Transfer.**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.

<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
<b>FACT</b>	Use, Types of heat Exchangers.	Explanation in classroom using chart and ppt
<b>CONCEPT</b>	Models of Heat Exchangers.	Explanation in classroom using chart and ppt
<b>PRINCIPLE</b>	Fourier's law Stefan-Boltzman law Radiation	Explanation in classroom using chart/Model and ppt
<b>PROCEDURE</b>	Const. & Working of different types of Heat Exchangers.	Explanation in classroom using chart/Model and ppt
<b>APPLICATION</b>	Application of Steam Heat Exchangers.	Explanation in classroom using chart/Model and ppt

Learning Resources: Model, Chart, PPT

Books:

- Title: 1) Course in Thermal Engineering by R.K.Rajput  
 2) Course in Thermal Engineering by P.L.Ballaney  
 3) Thermal Engineering by B.K.Sakar

Teaching Aids: Black Board & Chocks ,PPT, Model Chart

PPTs:

Websites [www.slideshare.net](http://www.slideshare.net)

Lecture No.	Heat Transfer
1	Modes of heat transfer -Conduction
2	Convection, Radiation
3	Fourier's law, thermal conductivity
4	conduction through cylinder, thermal resistance
5	composite walls (Simple numerical)
6	Simple numerical on composite wall
7	Thermal Radiation, Absorptivity, Transmissivity
8	Reflectivity, Emissivity, black and gray bodies, Stefan-Boltzmann law.
9	Heat exchangers - Classification, Construction and working of Shell and tube, shell and coil type
10	Pipe in pipe type, plate type heat exchanger and its applications

## 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)

## 5.3 Details about conduct of assignments:

## 5.4 Strategies for Conduct of Practical:

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

1. Teacher shall ensure that required equipment are in working condition before

- start of experiment, also keep operating instruction manual available.
2. Explain prior concept to the students before starting of each experiment.
  3. List of questions to be given to the students at the end of each experiment.
  4. Teacher shall assess the performance of students continuously as per norms prescribed by MSBTE
  5. Teacher may suggest the students to refer additional related literature of Technical paper/Reference book/Seminar proceedings etc.
  6. during assessment teacher is expected to ask questions to the students to tap their achievements regarding related knowledge and skill so that students can Prepare while submitting record of practical.

#### 5.4.3 Preparation for conduct of practical

### **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:

<b>Roll No.</b>				
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**Test Paper - I**

Course Name: Diploma in Mechanical Engineering    Course Code: 17410

Semester: Fourth

Subject: Thermal Engineering

Marks: **25**

Time: **1 hour**

**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**

03 x 03 = 09

- a) Define Thermodynamics system and state its different types.
- b) Define Boyle's law and Charles's law.
- c) Draw P-h diagram for steam formation process.
- d) State Kelvin-Planck's Statement of second law of thermodynamics.
- e) State uses of steam table

**Q2. Attempt any Two**

04 x 02 = 08

- a) Prove the equivalence of Kelvin-Planck and clausius statement.
- b) Differentiate between Isothermal and Isentropic process.
- c) Define wet steam, dry steam, saturated steam and superheated steam.

**Q3. Attempt any Two**

04 x 02 = 08

- a) State limitation of first law of thermodynamics.
- b) One kg of gas undergoes isothermal compression, at 300°K., during which its volume is reduced to 1/5 of its original volume calculate (1) Work Transfer (2) Heat Transfer
- c) Explain Rankine cycle with P-V. And T-S diagram.

Questions paper prepared by

1) Mr. V. M. Khanke

2) Mr. R. B. Tirpude

<b>Roll No.</b>				
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## Test Paper – II

Course Name: Diploma in Mechanical Engineering    Course Code: 17410

Semester: Fourth

Subject: Thermal Engineering

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

03 x 03 = 09

- a) Define nozzle. Give its types.
- b) Explain the function of cooling tower in steam power plant.
- c) State Fourier's law of conduction.
- d) Draw a Neat sketch of regenerative feed heating.
- e) What is heat Transfer? State different modes of heat transfer.

### Q2. Attempt any Two

04 x 02 = 08

- a) Define and state significance of Mach number
- b) Differentiate between jet condenser and surface condenser.
- c) Derive an expression for Heat flow through composite wall.

### Q3. Attempt any Two

04 x 02 = 08

- a) Explain pressure compounding with neat sketch
- b) Differentiate between forced draught and induced draught.
- c) Explain properties of Black body and Gray body.

Sample Question Paper:

<b>Roll No.</b>				
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### Model Question Paper

Course Name: Diploma in Mechanical Engineering  
Course Name: Thermal Engineering  
Semester: Fourth  
Subject: Thermal Engineering  
Marks: 100

G- SCHEME  
Course Code: 17410

Time: 03 hours

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#### Instructions:

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

#### Question 1(A) Attempt Any Six

02X 06 = 12

- Define Pure Substance
- State Zeroth's law of thermodynamics
- Draw P-V and T-S Chart of Isobaric system
- State Avogadro's law
- State the application of Mollier chart
- Write Continuity equation of steam nozzle
- List out losses in steam turbines (Any Two)
- Write application of condenser(Any Two)

#### Question 1(B) Attempt Any Two

04 x 02 = 08

- Classify the Steam boiler on the basis of
  - Content in the tube
  - Circulation of water and steam
  - According to boiler use
  - According to axis of shell
- Explain Dalton's law of partial pressure & gives its application.
- Give any four applications of heat exchanger and material used for heat exchanger.

#### Question 2 Attempt Any Four

04 X 04 = 16

- Differentiate between Heat Engine and Heat Pump (Minimum Four point)
- Derive an Equation of State for a perfect gas
- Explain pressure temperature diagram for a pure substance
- What is compounding of turbines and explain any one types
- What is regenerative feed heating? What are the advantages of regenerative feed heating?
- Explain a quasi static process with example

**Q3. Attempt any Four**

04 X 04 = 16

- a) Explain Clausius statement and its equivalence
- b) Write equation for i) change in internal energy ii) work done for polytropic process
- c) Explain construction and working of Cochran boiler
- d) Explain the concept of Mach number
- e) Differentiate between Natural draught and Induced draught of cooling towers
- f) Explain construction and working of shell & tube type heat exchanger

**Q4. Attempt any Four.**

04 X 04 = 16

- a) Explain with example extensive and intensive properties.
- b) List out various boiler mounting and explain any one
- c) What are the different types of steam nozzle and give its application?
- d) Explain the terms (i) Absorptivity (ii) Transmissivity (iii) Reflectivity (iv) Emissivity.
- e) What are the different sources of air leakages of steam condenser and state its effect .
- f) Explain the terms “Dryness fraction”, Degree of super heat

**Q5 Attempt any Two**

08 X 02 = 16

- a) Write steady flow energy equation and apply it to boiler, nozzle, and turbine.
- b) With neat Sketch Explain Construction and working of Impulse turbine and Reaction turbine
- c) Draw P-V. and T-S. Chart of following Vapours process
  - 1) Constant pressure
  - 2) Constant volume
  - 3) Constant enthalpy
  - 4) Constant entropy.

**Q6 Attempt any Two**

08 X 02 = 16

- a) State the Classification of condenser and explain construction and working of any one condenser
- b) Explain modes of heat transfer with an example.
- c) 1kg of Ideal gas is heated from 18<sup>0</sup>C to 90<sup>0</sup>C. Assuming  $R = 0.264 \text{ KJ/Kg}^0\text{K}$  and  $\gamma = 1.18$  for the gas, find
  - 1) Specific heats
  - 2) Change in Internal energy
  - 3) Change in enthalpy