

# **CURRICULUM REVISION PROJECT**

**2012**

**TEACHER GUIDE FOR**

**(INDUSTRIAL FLUID POWER- Code No.17608)**

**SIXTH SEMESTER MECHANICAL ENGINEERING  
GROUP**

**DECEMBER 2014**



**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.

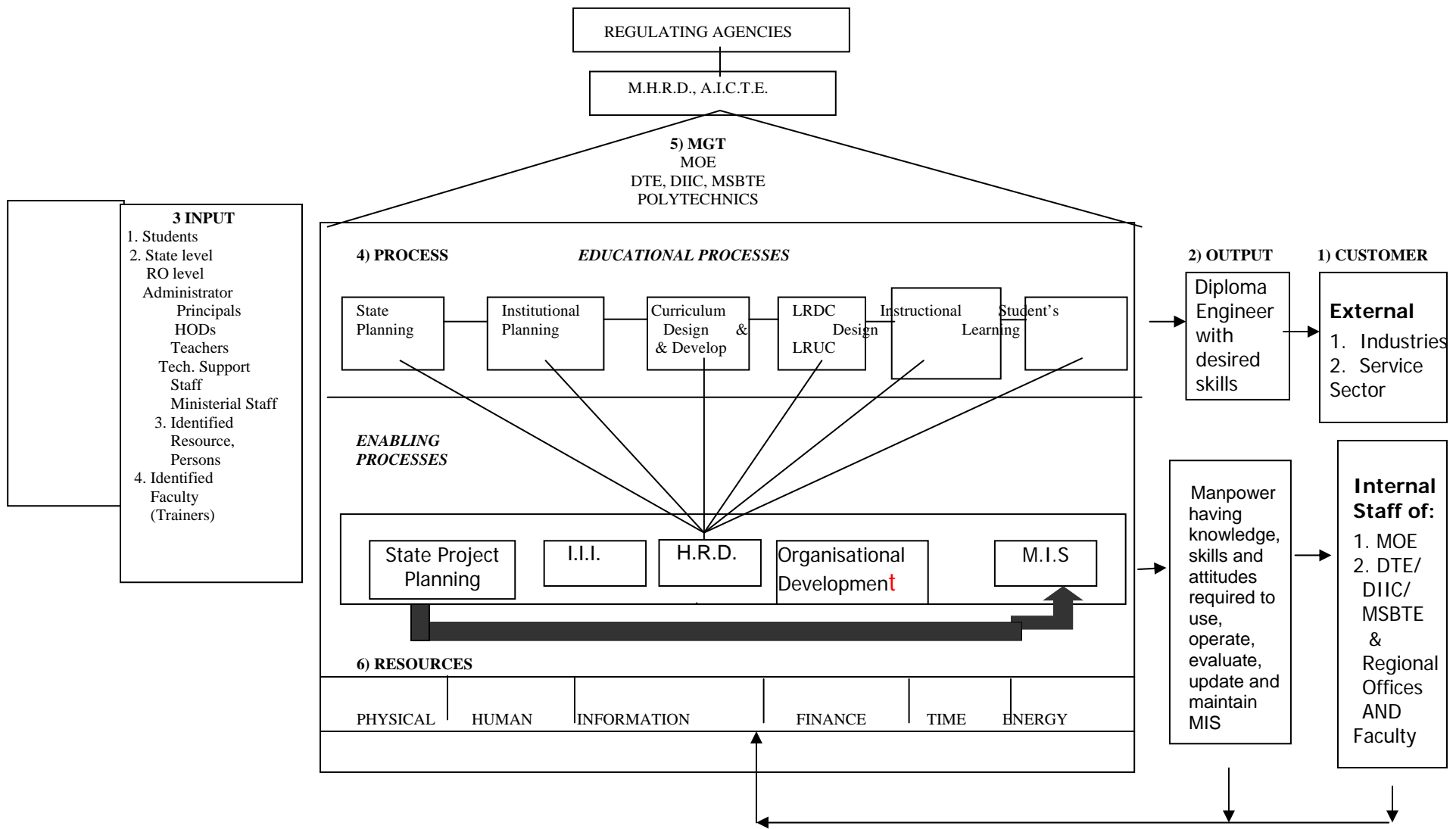
To fulfill the needs derived from systems approach following conceptual framework is considered:

## 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:**

- Reading and interpretation of production drawings

- Planning for materials, tools, processes and quality control techniques.
- Use of Operation and Maintenance Manuals
- Operation of new equipment, machinery and instruments like CNC, PLC, controllers, Robotics, EDM, ECM, laser cutting/welding, etc
- Use of CAD for 2D drawings and familiarity with CAD software like Idea, Catia, Pro-E etc (Awareness level)
- Use of Moderns manufacturing techniques used in industry like 5S, Six sigma, TQM, TPM, ZD, JIT, Kanban, Poka-Yoke, Quality Control Charts, Reliability engineering, etc.
- Design of Machine Element
- Problem solving skills
- Cost Reduction techniques
- Use of standards (ISO-9000, QS14000, etc)

#### **B) Motor Skills:**

- Maintenance of modern equipments and machineries
- Develop drafting Skills
- Operate Lathes, Drilling Machines, CNC Machines, Milling and Shaping Machines, Grinding Machines,
- Test Machine Performance
- Draw sketches of Civil engineering structures
- Carry out In process gauging
- Setting up of Automatic machines

#### **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 broadened 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 viz. 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:**

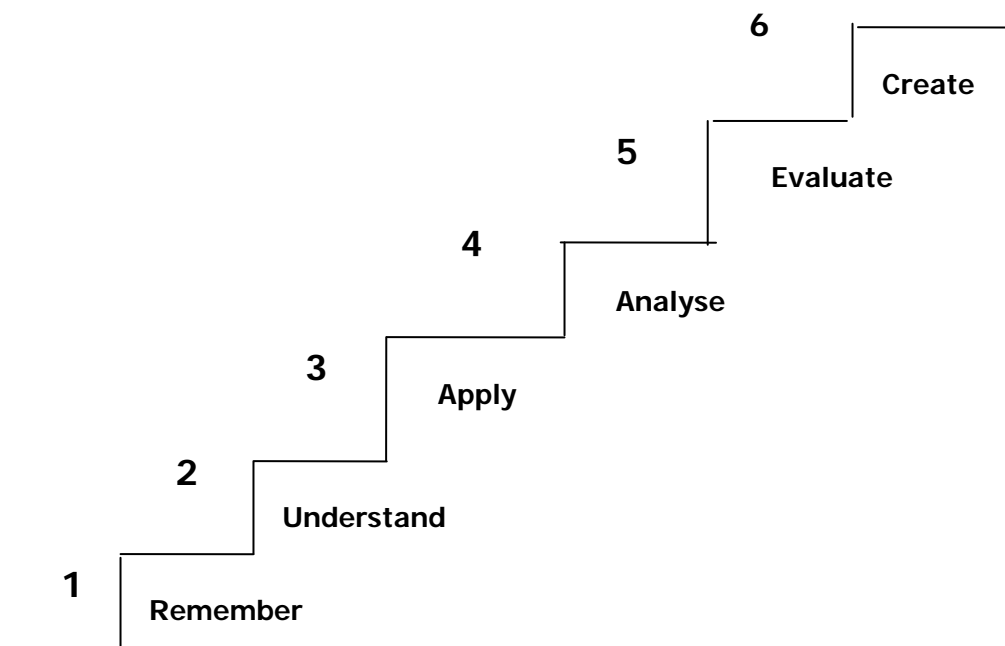
Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for

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:

##### 4.1 Sample Lesson Plan:

- Irrespective of teaching experience every teacher must plan each and every lecture to be delivered by him / her.
- The lesson planning may be noted on the paper or in case of senior teachers it may be planned in the mind.
- Sample format of lesson planning is given below:

<b>Sr. No.</b>	<b>Phase</b>	<b>Events</b>	<b>Time to be allotted</b>
1.	Introduction	<ul style="list-style-type: none"><li>• Recall of Prerequisites.</li><li>• Linking of previous knowledge with the new topic.</li><li>• Creating interest among the students.</li></ul>	5 to 10 Minutes
2.	Development	<ul style="list-style-type: none"><li>• Content Delivery (should be such that the interest should be created &amp; sustained among the students)</li><li>• Giving analogy for the abstract concepts.</li><li>• Giving examples from the world of work.</li><li>• Solving numerical problems.</li><li>• Asking questions to the students.</li><li>• Involving students in the teaching learning process.</li></ul>	40 to 50 Minutes
3.	Consolidation	<ul style="list-style-type: none"><li>• Summarizing the lecture.</li><li>• Creating curiosity among the students about the next lecture</li></ul>	5 to 10 Minutes

## 5. IMPLEMENTATION STRATEGY:

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

Topic I	Name: <b>BASICS OF OIL HYDRAULIC SYSTEMS</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>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>
	<b>FACT</b>	<b>Hydraulic pumps</b>	Actual demo. Of pump in laboratory and explain through charts, ppt's and animated videos.
	<b>CONCEPT</b>	<b>Conversion of mechanical energy to hydraulic (pressure) energy.</b>	i) Bring cut section model of Gear pump. ii) Disassemble model and show all parts. iii) Show how trap chamber is created between teeth of meshing gear. iv) Show how air is trapped and vacuum is created. V) Show and explain how trap oil chamber volume decreases and pressure increases. VI) Explain again cut section model of gear pump and demonstrate through charts, chalk and duster.
	<b>PRINCIPLE</b>	<b>Working of pumps and pressure regulation</b>	Use of ppt and animated videos.
	<b>PROCEDURE</b>	<b>Hydraulic Circuit preparation</b>	Demonstrate through actual trainer kit at laboratory
<b>APPLICATION</b>	<b>Earth movers, lifts,</b>	Show the operation using	

	<b>hoists, cranes etc</b>	charts or show operation of hydraulic machines on field if possible
<p>Learning Resources:</p> <p>Books:</p> <p>Title: 1) Oil Hydraulic system – principles and maintenance by – Majumdar S.R.  2) Hydraulics and pneumatics by - Stewart  3) Introduction To Hydraulics And Pneumatics- 1)S.Ilango, 2)V.Soundarajan  (Prentice Hall Of India Pvt.Ltd,New Delhi)</p> <p>Teaching Aids: <a href="http://www.youtube.com/watch?v=Kqc_vNkMkLg">www.youtube.com/watch?v=Kqc_vNkMkLg</a></p> <p>PPTs: <a href="http://www.atplearning.com/RG_Demo/FPSRG/PPT/FPS04.pps">www.atplearning.com/RG_Demo/FPSRG/PPT/FPS04.pps</a></p> <p>Websites: 1) <a href="http://www.slideshare.net">www.slideshare.net</a> to get the relevant power points</p>		
<b>Lecture No.</b>	<b>Topic/ Subtopic to be covered</b>	
1	Discuss about oil hydraulics system with practical examples.	
2	General layout of oil hydraulic system using block diagram, merits and demerits of oil hydraulic system.	
3	Types of oils Essential properties of oil used in oil hydraulic system.	
4	Classification of hydraulic pumps used in hydraulic circuit with symbol and applications of each.	
5	Construction and working principles of gear pump	
6	Construction and working principles of vane pump – balanced and unbalanced.	
7	Construction and working principles of vane pump – variable displacement	
8	Construction and working principles of Gerotor pump.	
9	Construction and working principles of Screw pump.	
10	Construction and working principles of Piston pump.	
11	Construction and working principles of Multi Piston pump	
12	Construction and working principles of Axial Piston pump- swash plate type.	

13	Construction and working principles of Bent Axis axial Piston pump.																		
14	Construction and working principles of Radial Piston pump																		
15	Application of hydraulic pumps and accessories																		
16	Revision of hydraulic pumps, oil hydraulic system and their applications.																		
Topic 2	<p>Name: <b>HYDRAULIC VALVES,ACTUATORS AND ACCESSORIES</b></p> <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 meaningful.</b></p> <p><b>e.g.</b></p> <table border="1"> <thead> <tr> <th><b>Knowledge Category</b></th> <th><b>Example/s of category</b></th> <th><b>Teaching methodology</b></th> </tr> </thead> <tbody> <tr> <td><b>FACT</b></td> <td><b>Valves, Actuators, pipes, hoses, fittings etc</b></td> <td>Demonstrate through charts , ppt chalk and duster</td> </tr> <tr> <td><b>CONCEPT</b></td> <td><b>Direction control, flow control, pressure control and regulations</b></td> <td>Explain with circuit by drawing or through charts and animations</td> </tr> <tr> <td><b>PRINCIPLE</b></td> <td><b>Automation of motive power</b></td> <td>Demonstrate through charts, ppt, chalk and board</td> </tr> <tr> <td><b>PROCEDURE</b></td> <td><b>Connection of components in the circuit</b></td> <td>Demonstrate using hydraulic trainer kit, various valves and flexible hoses with threaded or quick coupling</td> </tr> <tr> <td><b>APPLICATION</b></td> <td><b>Speed controlling of motion in hydraulic machine and machine tools</b></td> <td>Demonstrate using trainer kit, various valves and flexible hoses with threaded or quick coupling and allow the student to assemble and form hydraulic circuits</td> </tr> </tbody> </table> <p>Learning Resources::</p> <p>Books:1) Oil Hydraulic system – principles and maintenance by – Majumdar S.R.</p> <p>2) Hydraulics and pneumatics by - Stewart</p>	<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>	<b>FACT</b>	<b>Valves, Actuators, pipes, hoses, fittings etc</b>	Demonstrate through charts , ppt chalk and duster	<b>CONCEPT</b>	<b>Direction control, flow control, pressure control and regulations</b>	Explain with circuit by drawing or through charts and animations	<b>PRINCIPLE</b>	<b>Automation of motive power</b>	Demonstrate through charts, ppt, chalk and board	<b>PROCEDURE</b>	<b>Connection of components in the circuit</b>	Demonstrate using hydraulic trainer kit, various valves and flexible hoses with threaded or quick coupling	<b>APPLICATION</b>	<b>Speed controlling of motion in hydraulic machine and machine tools</b>	Demonstrate using trainer kit, various valves and flexible hoses with threaded or quick coupling and allow the student to assemble and form hydraulic circuits
<b>Knowledge Category</b>	<b>Example/s of category</b>	<b>Teaching methodology</b>																	
<b>FACT</b>	<b>Valves, Actuators, pipes, hoses, fittings etc</b>	Demonstrate through charts , ppt chalk and duster																	
<b>CONCEPT</b>	<b>Direction control, flow control, pressure control and regulations</b>	Explain with circuit by drawing or through charts and animations																	
<b>PRINCIPLE</b>	<b>Automation of motive power</b>	Demonstrate through charts, ppt, chalk and board																	
<b>PROCEDURE</b>	<b>Connection of components in the circuit</b>	Demonstrate using hydraulic trainer kit, various valves and flexible hoses with threaded or quick coupling																	
<b>APPLICATION</b>	<b>Speed controlling of motion in hydraulic machine and machine tools</b>	Demonstrate using trainer kit, various valves and flexible hoses with threaded or quick coupling and allow the student to assemble and form hydraulic circuits																	

	<p>3) Introduction To Hydraulics And Pneumatics- 1)S.IIango, 2)V.Soundarajan (Prentice Hall Of India Pvt.Ltd,New Delhi)</p> <p>Teaching Aids:</p> <ol style="list-style-type: none"> <li>1. Chalk Board</li> <li>2. Power Point Presentation</li> <li>3. Models and actual instruments</li> </ol> <p>PPT with Sample: Teacher to develop the power point presentations for the topics</p> <p>Websites: 1) <a href="http://www.slideshare.net">www.slideshare.net</a> to get the relevant power points</p>
<b>Lecture No.</b>	<b>Topic/ Subtopic to be covered</b>
1	Concepts of various elements of an oil hydraulic circuit.
2	Classification of Valves, Construction and working principles of pressure relief valve, its symbol and its importance in hydraulic circuit.
3	Construction and working principles of direct operated and pilot operated pressure control valve with symbol and application.
4	Construction and working principles of pressure reducing valve, pressure unloading valve with symbol, their functions and application.
5	Construction and working principles of sequence valve with symbol and application, counter balancing. Classification of direction control valves, construction and working of poppet valve.
6	Construction and working principles of spool type 2/2, 3/2, 4/2 ,5/3 direction control valve with symbol and application
7	Various methods of actuation of spools of direction control valve and their symbolic representation, types of different centre positions
8	Construction and working of check valve, pilot operated check valve with symbol, their functions and application.
9	Concept of flow control valve, Construction and working of pressure compensated and non pressure flow control valve with symbol, their functions and application
10	Revision and solving questions on hydraulic valves,actuators of MSBTE question papers
11	Classification of actuators , concept of rotary actuators, construction and working principles gear type rotary actuator.
12	construction and working principles vane type rotary actuator, radial piston motor, limited rotation motor.
13	construction and working principles axial piston motor- swash plate and bent axis..

14	Construction and working of single acting, double acting, tandem and telescopic linear actuators, their symbols and application.
15	Different methods of mountings. Construction and specification of hoses.
16	End fittings, couplings, oil filters.
17	Seals and gaskets, construction and working principles of accumulators.
18	Symbols of all above components of hydraulic system, their functions and symbol

Topic 3

**Name: OIL HYDRAULIC CIRCUITS**

**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>	<b>Hydraulic circuit</b>	Actual demo. Of hydraulic circuit in laboratory and allow the students to handle.
<b>CONCEPT</b>	<b>Linear and rotary motion of actuators, speed control operations meter in , meter out, sequencing operation</b>	Show piston rod speed control by connecting different valves on hydraulic trainer kit and explain using charts, ppt , chalk and board, .
<b>PRINCIPLE</b>	<b>Pascal's law.</b>	Demonstrate through appropriate ppt , chalk and board
<b>PROCEDURE</b>	<b>Hydraulic circuit preparation</b>	Demonstrate through hydraulic trainer kit
<b>APPLICATION</b>	<b>Design simple hydraulic circuit for shaper and milling machines. Fault finding and remedies in hydraulic circuits.</b>	Explain through appropriate ppt , chalk and board

Learning Resources:

Books:

	<p>Title: 1) Oil Hydraulic system – principles and maintenance by – Majumdar S.R.</p> <p>2) Hydraulics and pneumatics by - Stewart</p> <p>3) Introduction To Hydraulics And Pneumatics- 1)S.Ilango, 2)V.Soundarajan (Prentice Hall Of India Pvt.Ltd,New Delhi)</p> <p>Teaching Aids:</p> <ol style="list-style-type: none"> <li>1. Chalk Board</li> <li>2. Power Point Presentation</li> <li>3. Models and actual instruments</li> </ol> <p>PPT with Sample: Teacher to develop the power point presentations for the topics</p> <p>Websites: 1) <a href="http://www.slideshare.net">www.slideshare.net</a> to get the relevant power points</p>			
Lecture No.	Topic/ Subtopic to be covered			
1	Concept of developing and drawing general hydraulic system using symbols and line diagram.			
2	Meter –in , meter – out and bleed off circuit for speed control of linear actuator			
3	Regenerative hydraulic circuit, unloading, dual pump unloading circuit.			
4	Two cylinder synchronizing circuit by the use of mechanical coupling, flow divider and bi-directional hydraulic motor			
5	Sequencing circuit – travel dependent and pressure dependent			
6	Practical applications of hydraulic circuit-working principles of shaper machine.			
7	Working principles of hydraulic circuit of a milling machine.			
8	Practice session for development of hydraulic circuits for various operations and control			
Topic 4	<p>Name: <b>Introduction to components of pneumatic systems</b></p> <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 meaningful.</b></p> <p><b>e.g.</b></p> <table border="1"> <thead> <tr> <th>Knowledge Category</th> <th>Example/s of category</th> <th>Teaching methodology</th> </tr> </thead> </table>	Knowledge Category	Example/s of category	Teaching methodology
Knowledge Category	Example/s of category	Teaching methodology		

<b>FACT</b>	<b>Air Compressor, pneumatic circuit, valves, hoses &amp; fittings</b>	Explain using ppt, charts, chalk and board
<b>CONCEPT</b>	<b>Direction control, flow control, pressure control ,conditioning of air.( FRL unit)</b>	Show piston rod speed control by connecting different valves on pneumatic trainer kit and explain using charts, ppt , chalk and board, .
<b>PRINCIPLE</b>	<b>Automation of motive power by air pressure</b>	Explain through appropriate ppt , chalk and board
<b>PROCEDURE</b>	<b>Connection of components in the circuit using hoses and quick coupling</b>	Demonstrate using pneumatic trainer kit, connection of various valves and hoses with quick coupling
<b>APPLICATION</b>	<b>Designing of simple pneumatic circuit for speed control and sequencing.</b>	Explain using ppt, charts, chalk and board Demonstrate using pneumatic trainer kit, various valves and hoses with quick coupling, charts ,

Learning Resources::

Books: 1) Pneumatic system – principles and maintenance by – Majumdar S.R.

2) Hydraulics and pneumatics by - Stewart

3) Introduction To Hydraulics And Pneumatics- 1)S.Ilango, 2)V.Soundarajan  
(Prentice Hall Of India Pvt.Ltd,New Delhi)

Teaching Aids:

1. Chalk Board
2. Power Point Presentation
3. Models and actual instruments

PPT with Sample: Teacher to develop the power point presentations for the topics

Websites: 1) [www.slideshare.net](http://www.slideshare.net) to get the relevant power points

Lecture	Topic/ Subtopic to be covered
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No.										
1	General layout of pneumatic system, application of pneumatic system. functions of each components used in pneumatic system									
2	Merits and limitations of pneumatic system, selection of air compressor, classification of air compressor.									
3	Construction and working principles of single stage and multistage reciprocating air compressors									
4	Construction and working principles of Screw and vane type rotary air compressors with applications									
5	Construction and working principles of centrifugal and axial type rotary air compressors with applications									
6	Construction and working of pressure regulating valve – relieving and non relieving, Construction and working of 2/2, 3/2 pneumatic direction control valve.									
7	Construction and working of 4/2, 5/3 manual and pilot operated pneumatic direction control valve, methods of actuation of direction control valves with symbol									
8	Construction and working of check valves. Construction and working of flow control and flow control valve with built check valve.									
9	Construction and working of gear type, vane type and three lobe Pneumatic motors with symbol									
10	Construction and working of turbine, axial & radial piston rotary type Pneumatic motors with symbol and application.									
11	Construction and working of single acting, double acting reciprocating linear actuator with symbol.									
12	Construction of hoses, types of materials with specification, types of fitting-flared ferrule, screw & quick connectors.									
13	Construction and working of air filter ,pressure regulator & lubricator with symbolic representation.( frl unit )									
14	Revision on questions of MSBTE.									
Topic 5	<p><b>Name: PNEUMATIC CIRCUITS</b></p> <p>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 meaningful. e.g.</p> <table border="1"> <thead> <tr> <th>Knowledge Category</th> <th>Example/s of category</th> <th>Teaching methodology</th> </tr> </thead> <tbody> <tr> <td><b>FACT</b></td> <td><b>Pneumatic circuits</b></td> <td>Explain using ppt, charts, chalk and board Demonstrate using pneumatic trainer kit in laboratory</td> </tr> <tr> <td><b>CONCEPT</b></td> <td><b>Linear and rotary</b></td> <td>Demonstrate using</td> </tr> </tbody> </table>	Knowledge Category	Example/s of category	Teaching methodology	<b>FACT</b>	<b>Pneumatic circuits</b>	Explain using ppt, charts, chalk and board Demonstrate using pneumatic trainer kit in laboratory	<b>CONCEPT</b>	<b>Linear and rotary</b>	Demonstrate using
Knowledge Category	Example/s of category	Teaching methodology								
<b>FACT</b>	<b>Pneumatic circuits</b>	Explain using ppt, charts, chalk and board Demonstrate using pneumatic trainer kit in laboratory								
<b>CONCEPT</b>	<b>Linear and rotary</b>	Demonstrate using								

		<b>motion of actuators, speed control operations</b>	pneumatic trainer kit in laboratory
	<b>PRINCIPLE</b>		
	<b>PROCEDURE</b>	<b>Pneumatic circuit preparation</b>	Explain formation of pneumatic circuit using ppt, charts, chalk and board, Demonstrate using pneumatic trainer kit,
	<b>APPLICATION</b>	<b>Speed control circuits for double acting cylinders and bidirectional motors, sequencing circuits Fault finding and remedies in pneumatic circuits</b>	Demonstrate using pneumatic trainer kit and arrange industrial visit in forge shop, earth mover manufacturing unit

Learning Resources::

Books: 1) Pneumatic system – principles and maintenance by – Majumdar S.R.

2) Hydraulics and pneumatics by - Stewart

3) Introduction To Hydraulics And Pneumatics- 1)S.Ilango, 2)V.Soundarajan  
(Prentice Hall Of India Pvt.Ltd,New Delhi)

Teaching Aids:

1. Chalk Board
2. Power Point Presentation
3. Models and actual instruments

PPT with Sample: Teacher to develop the power point presentations for the topics

Websites: 1) [www.slideshare.net](http://www.slideshare.net) to get the relevant power points

<b>Lecture No.</b>	<b>Topic/ Subtopic to be covered</b>
1	Concept of developing and drawing general pneumatic circuit using symbols and line diagram.
2	Developing circuit for control of a single acting cylinder

3	Developing circuit for control of a double acting cylinder
4	Developing circuit for speed control of a double acting cylinder.
5	Developing circuit for speed control of a bidirectional air motor.
6	Construction & working of position based sequencing circuit.
7	Construction & working of sequencing circuit by using time delay valve.
8	Practice session for development of pneumatic circuits for various operations and control

## 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:

- i) Give assignment to students in groups after every chapter. Display the questions on notice board giving time limit of completion.
- ii) Marks out of 10 should be given to each assignment as per the quality, Correctness and presentation skill.
- iii) Check the assignment in front of each students during practical. Display best answers for reference to all the students.
- iv) Students should be asked to maintain a separate note book for Assignments.
- v) The subject Teacher may give separate set of question for a group of every 5 students in the class. This will generate a question bank with best possible solutions

## 5.4 Strategies for Conduct of Practical:

### 5.4.1 Laboratory Manuals: Purpose and Utility:

- 1) Intellectual and motor skill can be developed through manual.
- 2) Time required for conduction of practicals will be minimized.
- 3) Chances of error will be less.
- 4) Students can be assessed for various parameters by the teacher regarding understanding of principles and concepts of experiment conducted.
- 5) Student can also judged through question and answers given in manual related to experiment.
- 6) Mistake in literature, writing formulae, units etc. can be avoided.
- 7) Student can read and understand the procedure for conduction of experiment.
- 8) Concept of accuracy can be induced among students.
- 9) To maintain uniformity in conducting practical's.

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

- 1) Explain the objectives behind conducting any practical
- 2) Involve every student of a group in conduct of practical,
- 3) Rotate the students to carry out different task or observations during the practical
- 4) Question the students related to the principles, concept or procedure during conduction of practical.

<b>Sr.No.</b>	<b>Time in Minutes</b>	<b>Activity of teacher</b>	<b>Activity of student</b>
1	10	Explain the objective of experiment	Note down in their note book
2	20	Explain the experimental setup and procedure for conduction of practical	Observe and note down points
3	30	Observe & Guide the student for conducting practical	Conduct practical & note down the reading.
4	30	Observe & Guide the student for calculating end results	Carry out calculation based on the observation and readings taken
5	15	Discussion on end results and clearing queries of the students	Correction of results (if any) on the basis of discussions and queries
6	15	Checking manuals and taking attendance	Completion of manuals for assessment

### 5.4.3 Preparation for conduct of practical

- 1) Ask the student to keep the write up of experiment, tabular column before starting the practical
- 2) Check whether the equipments are in good working condition.
- 3) Check for accuracy of instruments.
- 4) See that proper safety will be maintained during the conduction of entire Practical.
- 5) Keep all required consumables and tools ready before starting of practicals.

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

### 6.1.1 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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17608

Institute Name:

Course Name: Mechanical Engg.

Course Code: ME

Semester :VI

Subject: **Industrial Fluid Power.**

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

#### Que.1: Attempt any **THREE**:

(3X3=9)

- a) Draw general layout of Hydraulic circuit and label the components.
- b) Draw symbol of ,
  - i) 5/3 DCV, ii) Variable flow control valve with integral check valve, iii) Pressure relief valve
- c) Classify Hydraulic actuators.
- d) State mounting methods for actuators.

#### Que.2: Attempt any **TWO**:

(2X4=8)

- a) Describe construction and working of External gear pump with a neat sketch.
- b) Classify accumulators and state their functions.
- c) What is the use of filter in Hydraulic circuit. Describe proportional flow filter with a neat sketch.

#### Que.3: Attempt any **TWO**:

(2X4=8)

- a) Draw & describe working of Direct operated pressure relief valve.

- b) State the methods of actuation and represent it symbolically.
- c) State types of oil seals and give at least two uses each in hydraulic circuit. \*

### 6.1.2 Sample Test Papers:

#### Sample Test Paper II

<b>Roll No.</b>				
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<b>17608</b>
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Institute Name:

Course Name: Mechanical Engg.

Course Code: ME

Semester :VI

Subject: **Industrial Fluid Power.**

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

#### Que.1: Attempt any **THREE**:

**(3X3=9)**

- a) Draw Bleed off circuit and label all the components.
- b) State merits and limitation of pneumatic system.
- c) Suggest and draw circuit for linear speed control during positive load..
- d) Why cushioning is provided in linear actuator? Draw symbol of double acting cylinder with cushioning on both ends.

#### Que.2: Attempt any **TWO**:

**(2X4=8)**

- a) Differentiate between Hydraulic and Pneumatic circuit with respect to the following parameter.

- i) Medium, ii) Pressure, iii) Application, iv) Lubrication.
- b) State different types of flow control valve and describe any one with neat sketch.
- c) Develop a pneumatic circuit for speed control of linear actuator using 3/2 DC valve.

**Que.3: Attempt any TWO:** (2X4=8)

- a) State types of air compressor and describe vane type air compressor.
- b) Draw symbol of FRL unit and state function of each element in it.
- c) Draw time delay pneumatic circuit and label all the components.

## **6.2 End of Semester Theory Paper**

### **6.2.1 Characteristics of a Good Examination Question Paper**

#### **6.2.1.1 Introduction**

While a student answers a question, he refers to his Long Term Memory (LTM) and sees if the answer could be readily available from the memorised data. If this is not possible, the student processes information from his LTM and then provides the answer. All these activities are related to processes taking place in the brain. Through question paper, we are trying to measure intellectual activities which may not have precise measurement. The question paper which we use to measure learning of a certain topic is usually called an instrument or a tool. The question paper or the instrument we are designing to measure achievement in a given subject/content should have certain qualities which will ensure a fair degree of confidence on the results of the examination.

Standard of any examination depends upon quality of question paper and therefore efforts must be made to see that question paper is set on scientific principles. A question paper can be called a good quality question paper if it possesses the following essential characteristics.

- Validity
- Reliability
- Objectivity
- Usability

#### **6.2.1.2 Validity**

Validity refers to the extent to which it measures what it intends to measure. If we design a test or a question paper to measure what students have learnt in a subject, say “Applied Mechanics”, it should measure their achievement in Applied Mechanics only, nothing else; and

the scores in this subject are not distorted by irrelevant factors. Basically, the, validity is always concerned with the specific use of the test results and the soundness of our proposed interpretations.

There are different types of validities of a test/question paper. In our examination question paper it is adequate and appropriate to consider only one type of validity i.e. content validity. The content validity is related to the extent to which the question paper conforms to the curriculum content and the pre-determined objectives. This validity is ensured by designing question paper that matches with the specification table, which contains content matter to be tested and the cognitive levels at which this content is to be tested.

### **6.2.1.3 Reliability**

Reliability refers to the consistency of measurement i.e. the consistency with which an examination question paper measures whatever it measures. If a teacher gives today an achievement test in a subject to his students, how similar would have been the student's scores had this test been given yesterday or tomorrow? How would the scores have varied had the teacher selected a different sample of equivalent questions? If it were a question paper containing essay type question, how would the scores have differed had a different teacher scored / evaluated it? These are the types of questions with which reliability is concerned. Unless the measurement can be shown to be reasonably consistent over different occasions or over different samples of the same performance domain, we can have little confidence in the results.

While measuring length, can any one get consistent results while using a tape made of elastic material? Depending upon how much the tape is stretched; different lengths would be obtained on each occasion. Reliability estimates of a question paper refer to the results of measurement. A reliable (consistent) measure is not necessarily valid. Reliability is strictly a statistical concept.

Reliability or the amount of faith which can be placed on the scores/marks of a question paper depends upon a number of factors. Some of these factors are –

i) **Clarity, Definiteness and Objectivity of the question paper**

Question paper which permits students to make widely divergent interpretations of what is expected of them (in their answer) is not likely to yield highly reliable results. For example, teacher assessing the answer books may have different expectations from students, if the questions are not specific, and are worded vaguely.

ii) **Examiners Objectivity**

This relates to consistency with which examiners examine and mark the answer scripts/books. If marks assigned to answers are greatly influenced by the examiner's state of mind at that moment, no one will keep faith in the assigned marks, and reliability of marking is adversely affected.

iii) **Number of Questions**

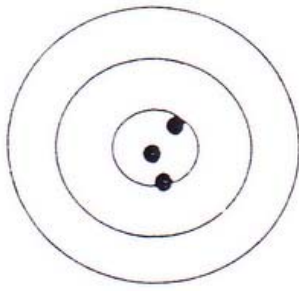
Researchers have shown that more number of questions in a question paper lead to more reliability. Reliability also depends upon the spread of scores, difficulty level of the question paper and objectivity of scoring.

The relation between validity and reliability is sometimes confusing to persons who come across these terms for the first time. Reliability (consistency) of measurement is needed to obtain valid results but we can have reliability without validity. The target shooting illustration, in the figure below, shows the concept that “reliability is a necessary but not a sufficient condition for validity”

Target

Target

Target

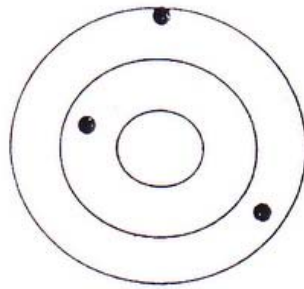


X

Reliable & Valid

invalid

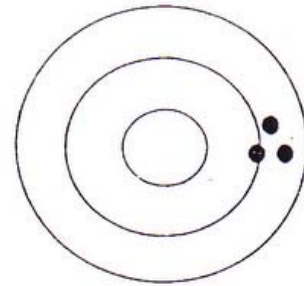
Shooting



Y

Unreliable & Invalid

Shooting



Z

Reliable but

Shooting

Three shooters X, Y, Z shoot at the target, each getting three shots. Shooter Y Shoots at different places far away from the bull's eye. Z consistently shoots at the border spot. X consistently shoots close to the bull's eye.

#### 6.2.1.4 Objectivity

This concept is related to marking of answer scripts. When answer scripts are assessed and marked in such a way that the total score obtained by students to not change appreciably, we say that the marking is objective. As against this, if extraneous personal biases and preferences of examiners influence marking of answer scripts, the assessment is subjective in nature. Thus objectivity implies assessment free from all extraneous factors and is opposite to subjectivity.

The element of subjectivity can be substantially reduced and objectivity improved, if the following steps are taken.

1. Designing an assessment scheme for a course.
2. Developing specification table for question paper indicating distribution of marks for different topics and levels.
3. Preparing a format of question paper showing distribution of topics in different questions, and indicating types of questions for abilities to be tested.
4. Designing question paper as per specification table.

5. Editing the question paper so that it meets all the criteria and conform to the specification table.
6. Developing scheme of marking for the answers to supply type questions (i.e. questions which make students to provide answers in sentence/figural/graphical form). This is the most necessary requirement for reducing subjectivity.

#### **6.2.1.5 Usability or Practicability**

An examination system should be so designed that it is possible to implement it without much problems or difficulties. The system should not be something that looks good or ideal on paper but can't be implemented. In addition to providing examination results that possess a satisfactory degree of reliability and validity, an examination system should also satisfy certain other practical requirements, given below.

- i) The system is economical from the point of view of both money and time.
- ii) It should be easy for administration and marking.
- iii) The system should be simple enough to be properly understood by all the concerned persons.

#### **6.2.1.6 How to Ensure Reasonable Validity?**

In order to have a valid test or an evaluation procedure, we must ensure that it is relevant to the purpose for which it is to be used; it means that there should be a close relationship between validity of a question paper and objectives of the test. In simpler words, by test validity we mean the accuracy, conformity and effectiveness with which the test measures what it intends to measure (Objectives).

The following steps can help to ensure reasonable degree of validity:

- a) Specify the purpose of assessment.
- b) Clearly define the objectives.
- c) Divide the course content into convenient chapters.
- d) Provide proportional weightage to each chapter.
- e) Provide proportional weightage to different objectives and their levels.
- f) Develop question on each of the sampled cognitive process dimension in each unit in accordance with the weightage assigned.
- g) Avoid providing free option like 'attempt any 6 out of 9'. However, internal option of "either", "or" type can be given with proper care of content and objectives.

It can be noticed that the only assurance we have that a test is a *valid* measure of the intended learning outcomes, is to use a systematic procedure for obtaining a representative sample of the curriculum in the question paper. The table of specifications is a device which provides the procedure for obtaining a representative sample of curriculum in the question paper and thus ensures content validity.

## **6.2.2. Approach for Designing Good Question Paper**

### **6.2.2.1 Concept of Specification Table**

A table of specification is a blue print for test or question paper design. Just as an engineer prepares a blue print before constructing a structure, a specification table is prepared in advance of the examination, so that a valid test could be designed.

In fact, a Table of Specifications is a sampling plan of the objectives to be tested in the test. This ensures following things:

- All important topics of the subject matter are adequately represented.
- There is no undue weightage given to any particular topic/topics.
- No content area worthwhile for testing is omitted from the test.
- The test samples adequate proportion of abilities at different taxonomy levels, in each part.

### **6.2.2.2 Guidelines for Preparing Specification Table**

1. Study the two dimensional table of objectives
2. Use the weightages of marks (out of 80) for each chapter/topic in the subject
3. In assigning relative weightages to each topic and level of learning outcomes, a number of factors have been considered. These factors are:
  - How important is each topic in relation with total learning experience?
  - How much time is expected to be devoted to each topic during instructions?
  - What relative importance does curriculum assign to each topic?
  - At what levels is the topic taught?
  - What amount of emphasis is given for each topic at what levels?

Specification table should consider the following:

- Content to be observed
- Objectives to be achieved
- Levels of objectives

➤ Total time and marks for the paper

1. The specification table consists of chapters/topics and levels of cognitive process dimension like R, U, A.

These cognitive process dimensions are –

R = Remember

U = Understand

A = Analyse / Apply

5. Review the chapter/topic and think about probable distribution of marks at the three levels (R, U, A,) for assessment. Normally distribution be done in multiples of two marks. Enter marks for each topic under the levels R, U, A.
6. Make total of vertical columns R, U, A. Suggested distribution is R=10% to 30%, U=40% to 55% and A=30% to 45% depending upon the level of the students.

A Sample Classification Table is given below with arbitrary marks.

**6.3.3 Sample Question Paper:**

<b>Exam Seat No.</b>									
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**17608**

**Maharashtra State Board of Technical Education**

Course Name: **Mechanical Engg.**

Course Code: **ME6G**

Semester: **VI**

Title of the Subject: **Industrial Fluid Power**

Subject Code: **17608**

Marks: **100**

Time: **03 hrs.**

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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 Three:**

**12**

- Describe with neat sketch general layout of hydraulic system.
- Draw symbol of,
  - Unidirectional hydraulic pump,
  - Temperature and pressure compensated flow control valve,
  - Pressure relief valve,
  - Pedal operated 4/3 DC valve.
- Give merits and limitations of hydraulic system.
- Describe construction and working of pressure reducing valve with line sketch.

**Q1. B) Attempt any One:**

**6**

- Describe the construction and working of radial piston pump.
- With a neat sketch describe pressure compensated flow control valve. Also show symbol of the same.

**Q2. Attempt any Two:**

**16**

- a) Describe how speed of cutting stroke of shaper machine is regulated with neat labeled sketch.
- b) State any two applications of 3 X 2 DC pneumatic valve with suitable circuit diagram.
- c) Using DA cylinder, flow control valve with check valve, pressure relief valve, filter, DC valve develop a circuit for speed control during a return stroke.

**Q3. Attempt any Four:**

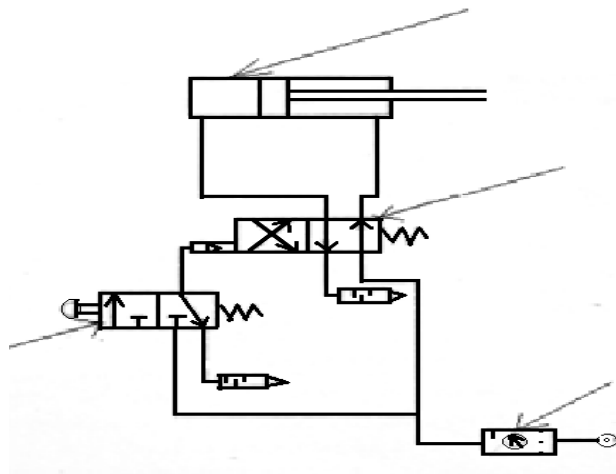
**16**

- a) Give classification of DC valve on following basis,
  - i) Actuation, ii) Port and position
- b) Give one function of filter, oil seal, accumulator and pressure relief valve used in hydraulic circuit.
- c) Draw labeled meter in circuit and describe its operation.
- d) List the essential properties of oil used in hydraulic system
- e) Give the function of FRL unit and also draw its symbol.

**Q4. A) Attempt any Three :**

**12**

- a) Describe pressure regulating valve with neat sketch.
- b) Rearrange the following component and draw block diagram of general pneumatic system i) Flow Control Valve, ii) Compressor, iii) Direction Control Valve, iv) FRL Unit, v) Actuator, vi) Muffler.
- c) With neat sketch describe construction and working of pneumatic DA cylinder.
- d) From a given circuit answer the following question



- i) Name the circuit and give its application.
- ii) Name the component represented by arrow.

**Q4.B) Attempt any One:**

**6**

- a) Suggest suitable system with reasoning for following applications
  - i) JCB, ii) Robot arm, iii) Universal testing machine, iv) Bolt tightening gun.
- b) Describe with neat sketch working of variable displacement vane type pump and also draw symbol.

**Q 5. Attempt any Two:**

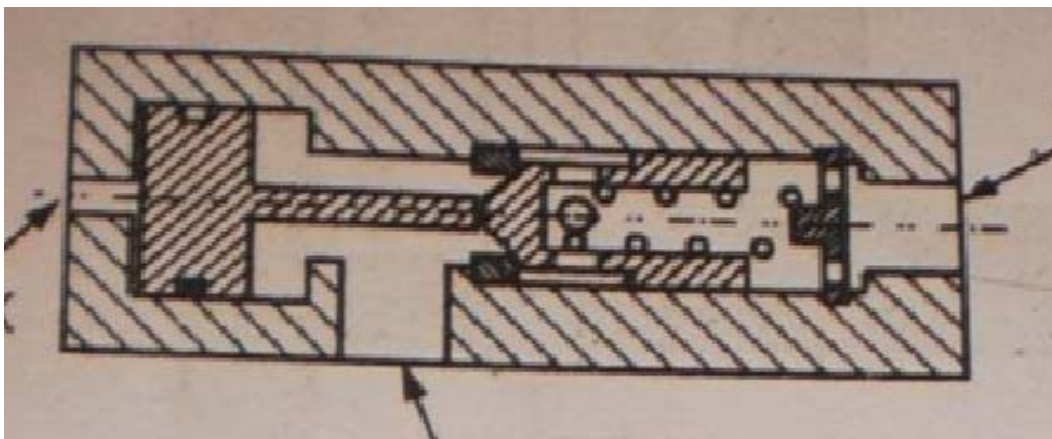
**16**

- a) Classify pneumatic actuators on the basis of i) Motion ii) Mode of action iii) Displacement and describe telescopic cylinder with sketch.
- b) Develop a pneumatic circuit for operation of two DA cylinders such that one operates after other at a certain time interval using time delay valve.
- c) Describe with neat sketch how speed of bidirectional air motor is controlled.

**Q 6. Attempt any Four :**

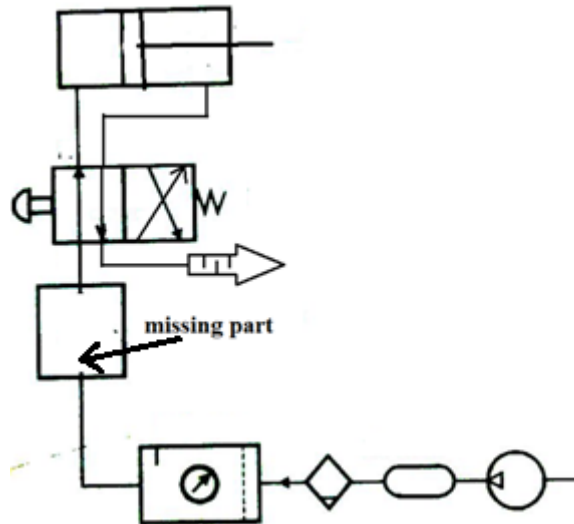
**16**

- a) Describe with neat sketch construction and working of pneumatic hose.
- b) List the various components of pneumatic circuit and give its application.
- c) State the application of hydraulic system.
- d) From the given component answer the following question.



- i) Write the name of shown component.
- ii) Name the parts denoted by arrow.
- iii) Give its application.
- iv) Draw the symbol

e) From the given pneumatic circuit answer the following question.



- i) Identify and draw missing part.
- ii) Name the circuit.
- iii) State the function of missing part (component).
- iv) If missing component is not added to the circuit state which circuit will be obtained.