CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR

(Hydraulics and Pneumatics 17522)

FIFTH SEMESTER AUTOMOBILE ENGINEERING GROUP

JUNE 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.

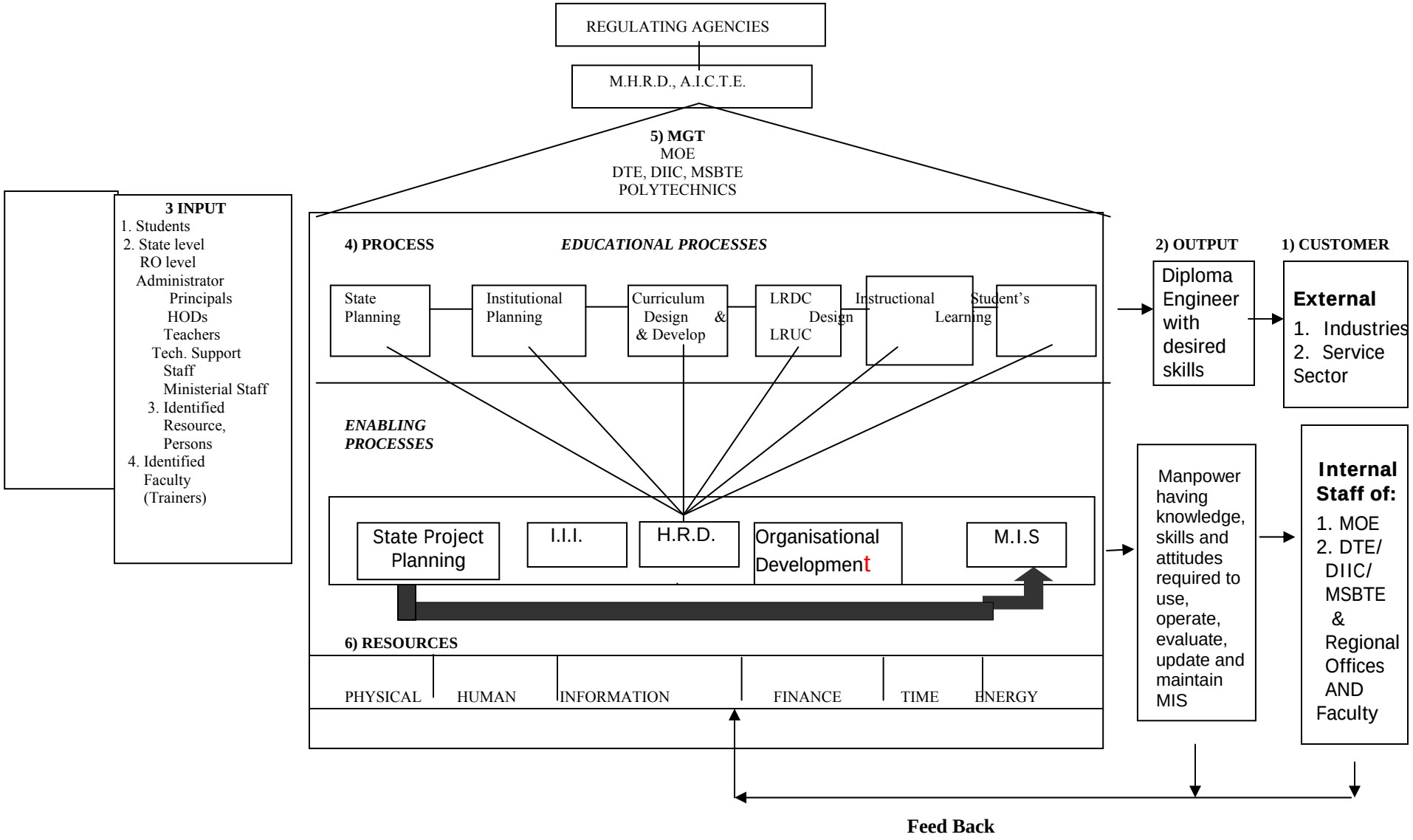


Fig 1 Systems Approach

1.4 Curriculum goals

1. To develop l. confidence in students by providing more exposure to industry experience and world of work at global leve
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 Automobile Engineering drawings.

2) Prepare estimates and bill of quantities.
3) Carryout Automobile engineering survey.
4) Design simple Automobile 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 Automobile engineering software.
9) Follow various standards and codes.
10) Maintain records in various formats.
11) Carry out Automobile maintenance.
12) Prepare various Automobile plans as per requirements by using appropriate byelaws.
13) Supervise assembly work.
14) Select appropriate technique for quality control.

B) Motor Skills.

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

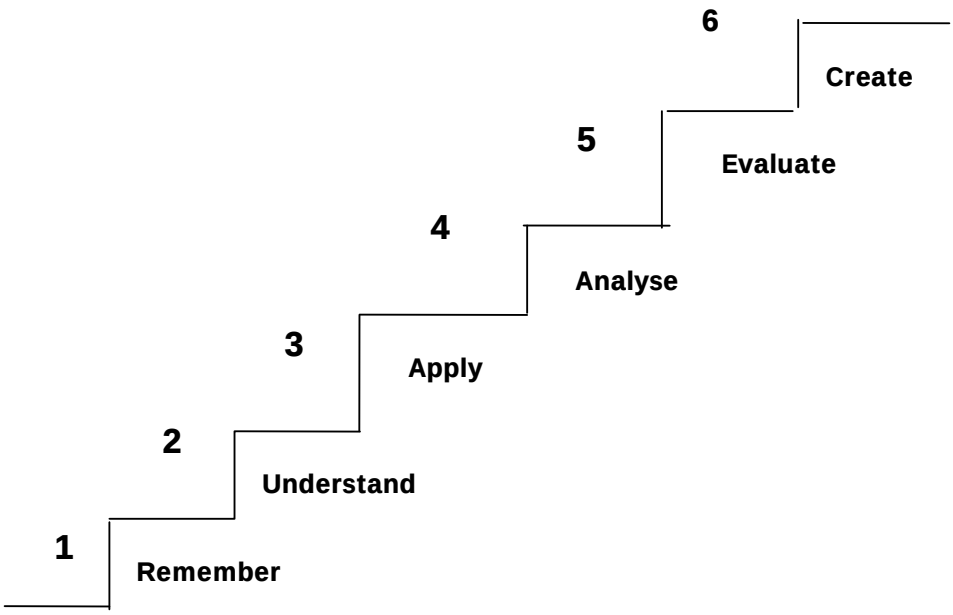
2.3 LEVELS OF LEARNING:

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 ad 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**
Remember – 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
Understand – 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.
Apply – 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.
Analyze – Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of the parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than "understand" and apply because they require an understanding of both the content and the structural form of the material.	Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/ adequacy of data.	Breakdown, diagram, differentiate, discriminate, distinguish, identify illustrate, infer, outline, point out, relate, select, separate, subdivide.

2.4.2 Categories of Knowledge Dimension

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

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

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

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

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

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

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

2.5 Components of Curriculum:

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

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

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

Objectives indicate what is achievable and hence 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 studing 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 I 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 tearing, this type of rote learning is not desirable. Adolescents (teenagers) and adults do not accept things without understanding.

3.1.3 Concept Attributes:

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

Example: The Concept **of Friction**

Attributes:

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

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

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

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

3.1.4 PRINCIPLES:

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

For Example: (related concepts are underlined)

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

3.1.5 APPLICATIONS:

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

For example:

1. Ohm's law can be applied to find out the unknown quantity (voltage, current, and resistance).

2. Design of a structure can be made based on related principles and theories.

3. Principles of learning and events of instruction can be applied in 'Designing a lesson Plan' and 'Presenting the lesson in the classroom".

4, The above principles can also be applied while preparing textbooks, workbooks, learning packages and laboratory manuals to be used by the students.

3.1.6 PROCEDURES:

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

For Example:

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

3.1.7 SKILLS (PSYCHOMOTOR):

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

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

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

For Example:

1. Welding a butt joint,

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

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

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

3.2 TEACHING OF CONCEPTS;

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

Steps Suggested:

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

3.3 TEACHING OF PRINCIPLES:

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

Steps:

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

3.4 CONCLUSION:

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

4.CURRICULUM:

COURSE NAME : AUTOMOBILE ENGINEERING

COURSE CODE : AE

SEMESTER/YEAR : FIFTH

SUBJECT TITLE : Hydraulics And Pneumatics

SUBJECT CODE :17522

Teaching and Examination Scheme:

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

 # - External @ - Internal * On Line Examination

TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term work

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:

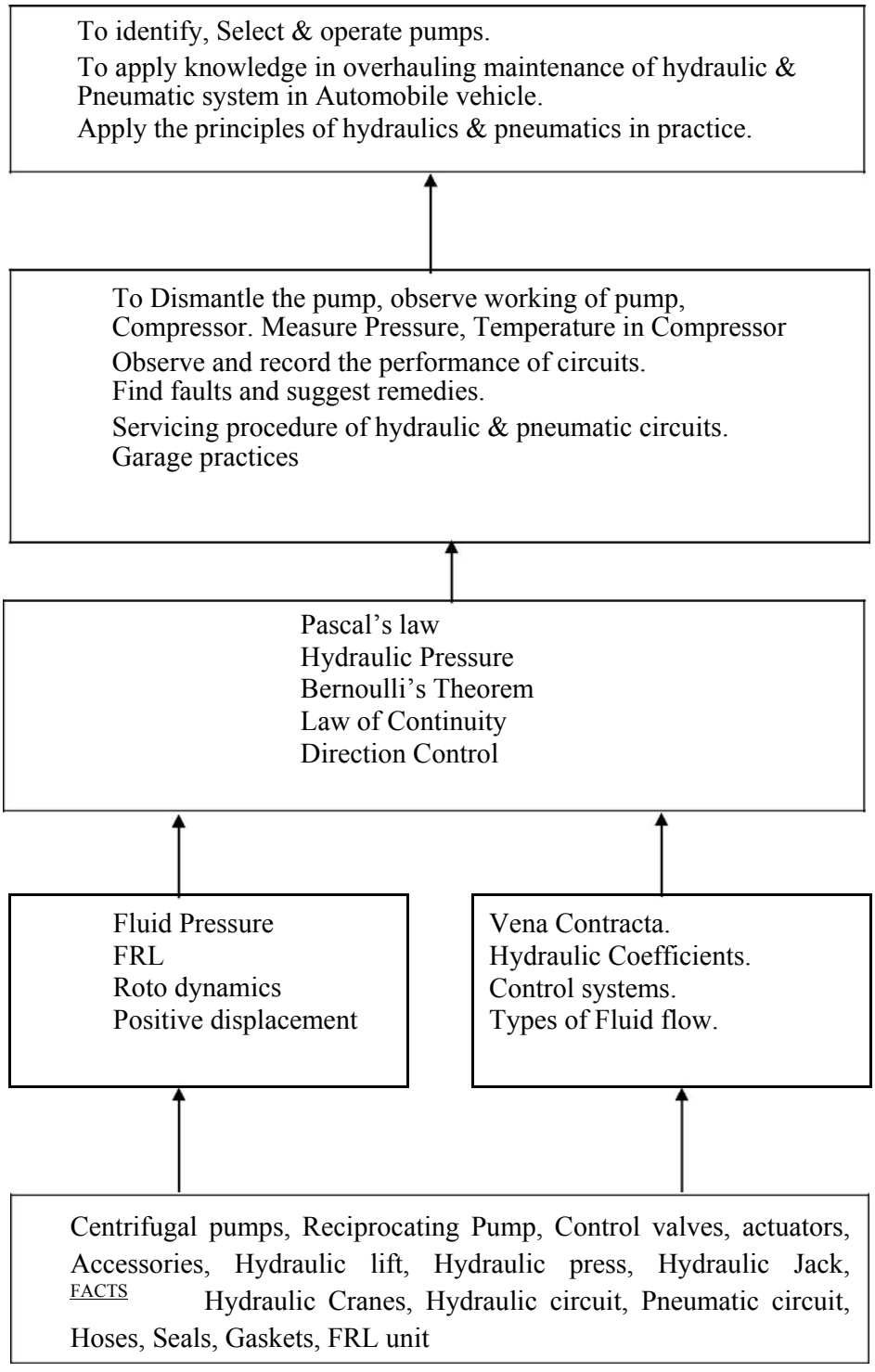
There is hardly any automobile as well as manufacturing industry and automobile service station without Hydraulics and Pneumatics system. The diploma holders are required to work with those systems, their components and troubleshooting. This is core technology subject which provides knowledge of constructing Hydraulics and Pneumatics circuits and its applications to industrial and mobile hydraulics and pneumatics. The subject requires the knowledge of Basic Engineering Science, Applied mechanics, Automobile Manufacturing Systems etc. This subject will be directly useful to the student in the industrial environment.

General Objectives:

Student will be able to

- Understand the basic properties of fluid, pressure measurement techniques, important principles of hydraulics / Pneumatics with their applications and hydraulic/Pneumatic devices used in practice.
- Identify fluid power system components like Pumps, actuators, valve, filters, and to construct the Hydraulic and Pneumatic circuits for various applications.
- Preparation of maintenance schedule and select appropriate tools to dismantle and assemble the components.
- Diagnose probable causes of failure of components of hydraulic and pneumatic circuits. Including power pack.
- Analysis of the conditions of fittings, oil, pipes, seals and packing of hydraulic systems in automobile vehicles.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
1. Overview of Fluid Mechanics. 22 Marks Specific Objectives: • Know the types of fluids used and their properties • Understand types of fluid flows • know fluid pressure measurement and measuring gauges • Understand principle used in hydrodynamics Contents: 1.1 Fluid Fundamentals. 08 Marks • Classification of Fluid, Properties of fluids like Specific Weight, Specific gravity, Surface tension, Capillarity, Viscosity. Specification of hydraulic oil • Pascal's law. • Types of fluid flow- Steady, unsteady, rotational, irrational, laminar, turbulent, one, two and three dimensional flow, Uniform and non uniform flow. (Definitions and applications only) Pressure Measurement. • Concept of atmospheric pressure, gauge pressure, vacuum pressure, absolute Pressure. • Pressure Gauges - Piezometer tube, simple and differential manometer, micro – manometer. (Theoretical Treatment only, No Analytical treatment / Problems on Manometers.) Bourdon tube pressure gauge. 1.2 Hydrodynamics. 14 Marks • Basic principles of fluid flow • Law of continuity and its applications. • Energy possessed by the liquid in motion. • Bernoulli's theorem and its applications such as Venturimeter, Orifice meter and pitot tube. (Analytical treatment with derivation for measurement of discharge is expected). Hydraulic coefficients • Concept of Vena Contracta. • Coefficient of contraction, coefficient of velocity, coefficient of discharge, Coefficient of resistance. Relation between the hydraulic coefficient	**10**	**22**
2. Hydraulic Devices 16 Marks Specific Objectives: • Know working of pumps • Select proper pumping devices • Find faults in pumps • Understand use of air vessel Contents: 2.1 Centrifugal Pumps. 08 Marks • Types, Construction and working of centrifugal pump • Types of casing. Need of priming. • Heads, Losses and Efficiencies of Centrifugal Pump. (No Analytical Treatment.) • Net positive suction head • Fault findings and remedies. • Pump selection.	**08**	**16**

2.2 Reciprocating Pumps 08 Marks - Construction and Working of single and Double Acting Reciprocating pump. - Positive and Negative slip. - Air vessels - their function and Advantage. - Power and Efficiencies of Reciprocation Pump. (No Analytical Treatment.) - Reasons of cavitations and separation. - Comparison between Reciprocating and Centrifugal Pump		
3. Miscellaneous Fluid Machines 12 Marks Specific Objectives: - Apply Pascal's law in various hydraulic devices - Know working of other types of pumps Contents: 3.1 Simple Hydraulic Devices. - Working principles, construction and applications of Hydraulic jack, Hydraulic ram, Hydraulic lift, Hydraulic press. 3.2 Other Pumping Devices. - Gear pumps used in hydraulic circuits, Vane type, Swash plate type pump. Comparison of above pumps for various characteristics and their applications.	**06**	**12**
4.Basic Components Of Hydraulic and Pneumatic Systems 18 Marks Specific Objectives: - Make them familiar with various hydraulic and pneumatic symbols - Understand working of actuators and valves Contents: 4.1 Hydraulic and Pneumatic actuators. 10 marks - Hydraulic Actuators - Hydraulic cylinders (single, double acting and telescopic) –construction and working, Hydraulic motors(gear and piston type) –construction and working - Pneumatic Actuators - Pneumatic cylinders (single and double acting) – construction and working, Air motors (gear and piston type) – construction and working 4.2 Valves for Hydraulic and Pneumatic systems. 08 Marks - Classifications of valves, poppet, ball, needle, throttle, pressure control directional control, sequencing synchronizing ,rotary spool, sliding spool two position, multi position. Non-return valves. Proportionating valve - Construction and operation of above valves.	**08**	**18**
5. Accessories of Hydraulic and Pneumatic systems 12 Marks Specific Objectives: - Understand function of filters, hoses and gaskets - Know use of gaskets and filters for specific applications Contents: 5.1 Filters - Hydraulic filters and strainers – full flow and proportional types, function and working, difference between filters and strainers. - Pneumatic filters –screen type and mechanical type, function and working, FRL unit 5.2 Hoses and Connectors for hydraulic and pneumatic systems - Types,	**06**	**12**

construction and applications. 5.3 Seals and Gaskets for hydraulic and pneumatic systems-Types, function,		
construction, commonly used seals and gasket materials.		
6. Hydraulic and Pneumatic Circuits Specific Objectives: • Compare hydraulic and pneumatic circuits • Understand various hydraulic and pneumatic circuits Contents: 6.1 Hydraulic Circuits 10 Marks • Hydraulic symbols • Meter in, Meter out. Bleed off, Sequencing. • Introduction to electro-hydraulics – concept, principles and applications • Applications of hydraulic circuits – Hydraulic power steering, Hydraulic brakes, milling machine, hydraulic press, 6.2 Simple Pneumatic Circuits. 10 Marks • Pneumatic symbols • Speed control circuit (Meter in, Meter out), Sequencing. • Applications of pneumatic circuits – Air brake, Low cost Automation in industries, Pneumatic power tools (drill, hammer, and grinder). • Comparison of Hydraulic and pneumatic circuits.	**10**	**20**
Total	**48**	**100**

Practical:

Skills to be developed:

Intellectual Skills:

1. Understand the basic principles of Hydraulics and their applications.
2. Measure discharge, pressure head and velocity of flow.
3. Ability of observation in working of hydraulic and pneumatic system.
4. Identify the component used in Hydraulic and Pneumatic Circuit. Design small circuits using these components.
5. Ability to Co-relate the performance hydraulic and pneumatic system.
6. Ability to identify the faults and suggest remedies.

Motor Skills:

1. Ability to join various hydraulic and pneumatic components to operate circuit
2. Maintain pumps
3. Carryout measurement of various parameters.

List of Practicals:

1. Experimental Verification of Bernoulli's Theorem.
2. Experimental determination of Coefficient of Discharge of Venturimeter / Orificemeter.
3. To study any hydraulic circuit in your laboratory, identify components, write functions of each component and prepare troubleshooting chart.
4. Dismantling and assembly of centrifugal pump and gear pump used in automobile, identify components, write functions of each components and prepare troubleshooting chart.
5. Construct two simple hydraulic circuits like meter in, meter out, bleed off and involving different valves etc. using trainer kit. Draw sketches of the circuit and write its working and applications.
6. Construct any two simple pneumatic circuits using trainer kit. Draw sketches of the circuit and write its working and applications.

7. Trial on centrifugal pump to determine its discharge and efficiency.
8. Trial on reciprocating pump to determine efficiency.

Learning Resources:

1. **Books:**

Sr. No.	Author	Title	Publisher
1	Dr. P. N. Modi Dr. S.M. Seth	Hydraulic and Fluid Mechanics	Standard book house, Delhi
2	Pippengen and Hicks	Industrial Hydraulics	Tata McGraw Hill Int.
3	S. Ilango and V. Soundararajan	Introduction To Hydraulics And Pneumatics	PHI Learning Private Limited, New Delhi.
4	Anthony Esposito	Fluid Power	PEARSON Education Noida
5	R.J. Garde and A.G. Mirajgaoker	Engineering Fluid Mechanics	SITECH Publications (India) PVT. LTD.
6	K. Shanmuga Sundaram	Hydraulic and Pneumatic controls	S. Chand
7	----------	Vicker's Industrial Hydraulic Manual	Vicker's system international Ltd. Pimpri, Pune – 411018

2. **CDs, PPTs Etc.:**
   - **Introduction to Pneumatics**
   - **Compressor and compressed air system-presentation from the "Energy Efficient guide for industry in Asia"**

3. **IS, BIS and International Codes:**
   BS2917/ISO 1219-1

4. **Websites:**
   www.mechanisms101.com/
   www.bimba.com/products/prod7.htm
   www.teamdavinci.com/understanting_pneumatics.htm
   www.PneumaticsFIRST.org
   www.energyefficiencyasia.org

5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic I — Name**: Overview of Fluid Mechanics**

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
FACT	Different types of fluids like water, oil, air	Demonstrate in lab.Show different fluids.
CONCEPT	Specific Weight, Specific gravity, Surface tension, Capillarity, Viscosity. Pressure Measurement. Pressure Gauges - Hydraulic coefficients Fluid Mechanics and Hydrodynamics. Venturi effect.	Explain the concept with chalk and board , also show actual demonstration of properties, surface tension property, Viscosity. Refer the lab manual also.
PRINCIPLE	Pascal's law. Law of continuity and its applications. Bernoulli's theorem. Differential pressure principle.	Explain the principle through demonstration in lab.
PROCEDURE	Procedure for pressure measurement, flow measurement etc.	Demonstrate the stepwise procedure for pressure measurement, flow measurement etc. Use ppt also.
APPLICATION	Piezometer tube, simple and differential manometer, micro – manometer. Venturimeter, Orifice meter and pitot tube.	Show and explain actual application in laboratory/classroom.

Learning Resources:

Books:
Title:-

1. Hydraulic and Fluid Mechanics, Dr. P. N. Modi, Dr. S.M. Seth Standard book house, Delhi
2. Fluid Power, Anthony Esposito, PEARSON Education Noida

	3. Engineering Fluid Mechanics, R.J. Garde and A.G. Mirajgaoker SITECH Publications (India) PVT. LTD. **Teaching Aids:** i) **Printed materials:** Handouts, Assignment sheets , Individualized learning materials, Resource materials for group exercises, Printed materials (ii) **Non-projected display materials**: Chalkboard, displays, Marker -board, Felt-board displays, Hook -And -loop board displays, Magnetic board displays , (whiteboard) Flipcharts, Charts and wall charts, Posters, Photographic prints , Mobiles, Models, Real objects. (iii) **Still projected display materials**: Overhead projector transparencies and similar materials, Slides. (iv)**Audio materials**: Radio broadcasts, Audiotapes (v) L**inked audio and still visual materials**; (vi) **Video materials**: vii) **Computer-mediated materials:** Tutor packages, laboratory packages, Data base system, Computer-managed learning systems, Interactive video systems. PPTs: Surface tension, Capillarity, Viscosity, Pressure Measurement. Pressure Gauges - Piezometer tube, simple and differential manometer, micro – manometer. Venturimeter, Orifice meter and pitot tube. Websites: http://www.engineershandbook.com/ http://www.engineersedge.com/ http://www.efunda.com http://www.mechanicalengineering.tv/ http://en.wikipedia.org/ http://www.mechanisms101.com http://www.saeindia.org http://www.howstuffworks.com
Lecture No.	Topic/ Subtopic to be covered
1	Fluid Fundamentals. Classification of Fluid, Properties of fluids like Specific Weight, Specific gravity, Surface tension, Capillarity, Viscosity. Specification of hydraulic oil
2	Pascal's law. Types of fluid flow- Steady, unsteady, rotational, irrational, laminar, turbulent, one, two and three dimensional flow, Uniform and non uniform flow. (Definitions and applications only) Pressure Measurement. Concept of atmospheric pressure, gauge pressure, vacuum pressure, absolute Pressure.
3	Pressure Gauges - Piezometer tube, simple and differential manometer, micro – manometer. (Theoretical Treatment only, No Analytical treatment / Problems on Manometers.) Bourdon tube pressure gauge.

4	Hydrodynamics, Basic principles of fluid flow
5	Law of continuity and its applications
6	Energy possessed by the liquid in motion.
7	Bernoulli's theorem and its applications such as Venturimeter, Orifice meter and pitot tube. (Analytical treatment with derivation for measurement of discharge is expected).
8	Hydraulic coefficients, Concept of Vena Contracta
9	Coefficient of contraction, coefficient of velocity,
10	Coefficient of discharge, Coefficient of resistance . Relation between the hydraulic coefficients.

Topic II

Name: Hydraulic Devices

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.

Knowledge Category	Example/s of category	Teaching methodology
FACT	Centrifugal Pump. Casing,	Demonstrate through models/PPT, simulations and animations
CONCEPT	Heads, Losses and Efficiencies, Net positive suction head, Positive and Negative slip.	Explain through PPT.
PRINCIPLE	Centrifugal force, suction and compression because of reciprocating mechanism.	Demonstrate through models/PPT, simulations and animations
PROCEDURE	Priming. Fault findings and remedies. Cavitation and separation.	Explain through PPT.
APPLICATION	Various applications in industry - petroleum, pharmaceutical.	Explain through PPT, simulations and animations. Ask students to deliver one lecture/seminar on any one application on his own preparation.

Learning Resources:

Books:

Title:-

1 Hydraulic and Fluid Mechanics, Dr. P. N. Modi, Dr. S.M. Seth
Standard book house, Delhi
2. Fluid Power, Anthony Esposito, PEARSON Education Noida
3. Engineering Fluid Mechanics, R.J. Garde and A.G. Mirajgaoker

	SITECH Publications (India) PVT. LTD. **Teaching Aids:** i) **Printed materials:** Handouts, Assignment sheets , Individualized learning materials, Resource materials for group exercises, Printed materials (ii) **Non-projected display materials**; Chalkboard, displays, Marker -board, Felt-board displays, Hook -And -loop board displays, Magnetic board displays , (whiteboard) Flipcharts, Charts and wall charts, Posters, Photographic prints , Mobiles, Models, Real objects. (iii) **Still projected display materials**; Overhead projector transparencies and similar materials, Slides, (iv)**Audio materials**; Radio broadcasts, Audiotapes (v) L**inked audio and still visual materials**; (vi) **Video materials**; vii) **Computer-mediated materials.** Tutor packages, laboratory packages, Data base system, Computer-managed learning systems, and Interactive video systems. PPT with Sample: Centrifugal Pumps, Construction and working of centrifugal pump Types of casing. Reciprocating Pumps. Air vessels. Websites: : http://www.engineershandbook.com/ http://www.engineersedge.com/ http://www.efunda.com http://www.mechanicalengineering.tv/ http://en.wikipedia.org/ http://www.mechanisms101.com http://www.saeindia.org http://www.howstuffworks.com
Lecture No.	Topic/ Subtopic to be covered
1	Centrifugal Pumps. Types, Construction and working of centrifugal pump
2	Types of casing. Need of priming.
3	Heads, Losses and Efficiencies of Centrifugal Pump. (No Analytical Treatment.) Net positive suction head
4	Fault findings and remedies. Pump selection.
5	Reciprocating Pumps Construction and Working of single and Double Acting Reciprocating pump. Positive and Negative slip. Air vessels - their function and Advantage.
6	Power and Efficiencies of Reciprocation Pump. (No Analytical Treatment.)
7	Reasons of cavitations and separation.
8	Comparison between Reciprocating and Centrifugal Pump

Topic III

Name: Miscellaneous Fluid Machines

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
FACT	Hydraulic jack, Hydraulic ram, Hydraulic lift, Hydraulic press. Gear pumps, Vane type, Swash plate type pump, used in hydraulic circuits.	Actual demonstration of models in the classroom/laboratory and allow the students to handle.
CONCEPT	Fluid flow, compressibility, Incomressibilty.	Show compressibility of air with the help of compressor and gauge etc.
PRINCIPLE	Pascal's law. Hydrodynamics	Demonstrate through appropriate ppt.
PROCEDURE	Working of jack, pumps	Demonstrate through models/PPT, simulations and animations.
APPLICATION	Hydraulic jack, press, lift.	Demonstrate through models/PPT, simulations and animations. Actual demonstration in the classroom/laboratory. Ask students to deliver one lecture/seminar on any one application on his own preparation.

Learning Resources:

Books:
Title:

1 Hydraulic and Fluid Mechanics, Dr. P. N. Modi, Dr. S.M. Seth
Standard book house, Delhi
2. Fluid Power, Anthony Esposito, PEARSON Education Noida
3. Engineering Fluid Mechanics, R.J. Garde and A.G. Mirajgaoker
SITECH Publications (India) PVT. LTD.

	Teaching Aids: i) **Printed materials:** Handouts, Assignment sheets , Individualized learning materials, Resource materials for group exercises, Printed materials (ii) **Non-projected display materials**; Chalkboard, displays, Marker -board, Felt-board displays, Hook -And -loop board displays, Magnetic board displays , (whiteboard) Flipcharts, Charts and wall charts, Posters, Photographic prints , Mobiles, Models, Real objects. (iii) **Still projected display materials**; Overhead projector transparencies and similar materials, Slides, (iv)**Audio materials**; Radio broadcasts, Audiotapes (v) L**inked audio and still visual materials**; (vi) **Video materials**; vii) **Computer-mediated materials.** Tutor packages, laboratory packages, Data base system, Computer-managed learning systems, Interactive video systems. **PPTs:** Construction and applications of Hydraulic jack, Hydraulic ram, Hydraulic lift, Hydraulic press. Gear pumps used in hydraulic circuits, Vane type, Swash plate type pump. **Websites:** http://www.engineershandbook.com/ http://www.engineersedge.com/ http://www.efunda.com http://www.mechanicalengineering.tv/ http://en.wikipedia.org/ http://www.mechanisms101.com http://www.saeindia.org http://www.howstuffworks.com http://www.hydraulicspneumatics.com http://www.hpmag.co.uk http://www.www.janatics.com http://www.vickers.com http://www.festo.in http://www.www.yukenindia.com http://www.smcin.com http://www.www.polyhydron.com
Lecture No.	Topic/ Subtopic to be covered
1	Simple Hydraulic Devices. Working principles, construction and applications of Hydraulic jack,
2	Hydraulic ram, Hydraulic lift, Hydraulic press.
3	Other Pumping Devices. Gear pumps used in hydraulic circuits,
4	Vane type, Swash plate type pump..

5	Comparison of above pumps for various characteristics and their applications
6	Various applications of above pumps.
Topic IV	**Name: Basic Components Of Hydraulic and Pneumatic Systems** **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.**

Knowledge Category	Example/s of category	Teaching methodology
FACT	Actuators, Hydraulic motors, Air motors Valves for Hydraulic and Pneumatic systems.	Actual demonstration of models in the classroom/laboratory and allow the students to handle.
CONCEPT	Pressure, force, Flow, Compressibility, incompressibility	Demonstrate through models/PPT, simulations and animations.
PRINCIPLE	Pascals' Law, hydro-dynamics. Energy Conversion	Demonstrate through models/PPT, simulations and animations.
PROCEDURE	S T E P" Pneumatics is a method of: S -toring and T -ransfering E -nergy to P -erform work… using Compressed Air.	Demonstrate through small setup such as paddle air filling machine and Bourdon tube pressure gauge.
APPLICATION	Air brake, Pneumatic power tools - drill, hammer, and grinder	Demonstrate through models/PPT, simulations and animations. Ask students to deliver one lecture on any one application on his own preparation.

Learning Resources:
Books:

Title:-

1. Industrial Hydraulics, Pippengen and Hicks,Tata McGraw Hill Int.
2. Introduction To Hydraulics And Pneumatics, S. Ilango and V. Soundararajan PHI Learning Private Limited, New Delhi.
3. Fluid Power, Anthony Esposito, PEARSON Education, Noida.
4. Hydraulic and Pneumatic controls,K. Shanmuga Sundaram, S. Chand
5. Vicker's Industrial Hydraulic Manual, Vicker's system international Ltd. Pimpri, Pune – 411018

	Teaching Aids: i) **Printed materials:** Handouts, Assignment sheets , Individualized learning materials, Resource materials for group exercises, Printed materials (ii) **Non-projected display materials**; Chalkboard, displays, Marker -board, Felt-board displays, Hook -And -loop board displays, Magnetic board displays , (whiteboard) Flipcharts, Charts and wall charts, Posters, Photographic prints , Mobiles, Models, Real objects. (iii) **Still projected display materials**; Overhead projector transparencies and similar materials, Slides, (iv)**Audio materials**; Radio broadcasts, Audiotapes (v) L**inked audio and still visual materials**; (vi) **Video materials**; vii) **Computer-mediated materials.** Tutor packages, laboratory packages, Data base system, Computer-managed learning systems, Interactive video systems. **PPT with Samples:** Hydraulic Actuators - Hydraulic cylinders (single, double acting and telescopic) –construction and working, Hydraulic motors (gear and piston type) –construction and working. Pneumatic Actuators - Pneumatic cylinders (single and double acting) –construction and working, Air motors (gear and piston type) – construction and working. Construction and operation of poppet, ball, needle, throttle, pressure control directional control, sequencing synchronizing ,rotary spool, sliding spool two position, multi position. Non-return valves, Proportionate valve. **Websites:** http://en.wikipedia.org/ http://www.mechanisms101.com http://www.saeindia.org http://www.howstuffworks.com http://www.hydraulicspneumatics.com http://www.hpmag.co.uk http://www.www.janatics.com http://www.vickers.com http://www.festo.in http://www.www.yukenindia.com http://www.smcin.com http://www.www.polyhydron.com
Lecture No.	Topic/ Subtopic to be covered
1	Hydraulic and Pneumatic actuators. Hydraulic Actuators - Hydraulic cylinders (single, double acting) –construction and working,
2	Hydraulic Actuators - Hydraulic cylinders (telescopic) –construction and working,
3	Hydraulic motors(gear and piston type) –construction and working
4	Pneumatic Actuators - Pneumatic cylinders (single and double acting) –construction

	and working,
5	Air motors (gear and piston type) – construction and working
6	Valves for Hydraulic and Pneumatic systems. Classifications of valves, poppet, ball, needle, throttle, pressure control directional control, ,
7	Sequencing synchronizing, rotary spool, sliding spool two position, multi position.
8	Non-return valves. Proportionate valve Construction and operation of above valves

Topic V

Name**: Accessories of Hydraulic and Pneumatic systems**

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
FACT	Filters and strainers, FRL unit, Hoses and Connectors for hydraulic and pneumatic systems. Seals and Gaskets.	Actual demonstration of models in the classroom/laboratory and allow the students to handle. Use manufacturers' catalogues.
CONCEPT	Fluid flow, Pressure, force.	Demonstrate through models/PPT, simulations and animations.
PRINCIPLE	Pascal's Law, Hydro dynamics.	Demonstrate through appropriate ppt
PROCEDURE	Working of filters and strainers, FRL unit,	Demonstrate through models/PPT/Actual laying of bricks on site
APPLICATION	Actual working of Pneumatic system.	Demonstrate through models/PPT, simulations and animations. Ask students to deliver one lecture/seminar on any one application on his own preparation.

Learning Resources:

Teaching Aids:
i) **Printed materials:** Handouts, Assignment sheets , Individualized learning materials, Resource materials for group exercises, Printed materials

	(ii) **Non-projected display materials**; Chalkboard, displays, Marker -board, Felt-board displays, Hook -And -loop board displays, Magnetic board displays , (whiteboard) Flipcharts, Charts and wall charts, Posters, Photographic prints , Mobiles, Models, Real objects. (iii) **Still projected display materials**; Overhead projector transparencies and similar materials, Slides, (iv)**Audio materials**; Radio broadcasts, Audiotapes (v) L**inked audio and still visual materials**; (vi) **Video materials**; vii) **Computer-mediated materials.** Tutor packages, laboratory packages, Data base system, Computer-managed learning systems, Interactive video systems. **Learning Resources:-** **Books:-** Title:- 1. Industrial Hydraulics, Pippengen and Hicks,Tata McGraw Hill Int. 2. Introduction To Hydraulics And Pneumatics, S. Ilango and V. Soundararajan PHI Learning Private Limited, New Delhi. 3. Fluid Power, Anthony Esposito, PEARSON Education, Noida. 4. Hydraulic and Pneumatic controls,K. Shanmuga Sundaram, S. Chand 5. Vicker's Industrial Hydraulic Manual, Vicker's system international Ltd. Pimpri, Pune – 411018 **PPTs with samples:** Hydraulic filters and strainers. Pneumatic filters, FRL unit. Hoses and Connectors for hydraulic and pneumatic systems - Types, construction. Seals and Gaskets application. **Websites:** http://en.wikipedia.org/ http://www.mechanisms101.com http://www.saeindia.org http://www.howstuffworks.com http://www.hydraulicspneumatics.com http://www.hpmag.co.uk http://www.www.janatics.com http://www.vickers.com http://www.festo.in http://www.www.yukenindia.com http://www.smcin.com http://www.www.polyhydron.com
Lecture No.	Topic/ Subtopic to be covered
1	Filters Hydraulic filters and strainers – full flow and proportional types,

2	Hydraulic filters and strainers - function and working,
3	Hydraulic filters and strainers - difference between filters and strainers.
4	Pneumatic filters –screen type and mechanical type, function and working, FRL unit
5	Hoses and Connectors for hydraulic and pneumatic systems - Types, construction and applications.
6	Seals and Gaskets for hydraulic and pneumatic systems-Types, function, construction, commonly used seals and gasket materials.

Topic VI

Name: Hydraulic and Pneumatic 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 meaningful.
e.g.

Knowledge Category	Example/s of category	Teaching methodology
FACT	Hydraulic, Pneumatic Circuits, symbols, Hydraulic power steering, Hydraulic brakes, milling machine, hydraulic press, Air brake,	Demonstrate through models/PPT, simulations and animations.
CONCEPT	Hydraulics, Pneumatics electro-hydraulics,	Demonstrate through models/PPT, simulations and animations.
PRINCIPLE	Pascal's Law, Hydro dynamics.	Demonstrate through models/PPT, simulations and animations.
PROCEDURE	Sequencing, Speed control circuit,	Demonstrate through models/PPT, simulations and animations.
APPLICATION	Hydraulic power steering, Hydraulic brakes, milling machine, hydraulic press, Air brake, Low cost Automation in industries, Pneumatic power tools (drill, hammer, and grinder).	Demonstrate through models/PPT, simulations and animations. Ask students to deliver one lecture/seminar on any one application on his own preparation.

Learning Resources:
Books:
Title:-
1. Industrial Hydraulics, Pippengen and Hicks,Tata McGraw Hill Int.
2. Introduction To Hydraulics And Pneumatics, S. Ilango and V. Soundararajan PHI Learning Private Limited, New Delhi.
3. Fluid Power, Anthony Esposito, PEARSON Education, Noida.
4. Hydraulic and Pneumatic controls,K. Shanmuga Sundaram, S. Chand

	5. Vicker's Industrial Hydraulic Manual, Vicker's system international Ltd. Pimpri, Pune – 411018 **Teaching Aids:** i) **Printed materials:** Handouts, Assignment sheets , Individualized learning materials, Resource materials for group exercises, Printed materials (ii) **Non-projected display materials**; Chalkboard, displays, Marker -board, Felt-board displays, Hook -And -loop board displays, Magnetic board displays , (whiteboard) Flipcharts, Charts and wall charts, Posters, Photographic prints , Mobiles, Models, Real objects. (iii) **Still projected display materials**; Overhead projector transparencies and similar materials, Slides, (iv)**Audio materials**; Radio broadcasts, Audiotapes (v) **Linked audio and still visual materials**; (vi) **Video materials**; vii) **Computer-mediated materials.** Tutor packages, laboratory packages, Data base system, Computer-managed learning systems, Interactive video systems. **PPT with Models:** Sequencing. Hydraulic power steering, Hydraulic brakes, milling machine, hydraulic press. Air brake, Low cost Automation in industries, Pneumatic power tools (drill, hammer, and grinder). **Websites:** http://en.wikipedia.org/ http://www.mechanisms101.com http://www.saeindia.org http://www.howstuffworks.com http://www.hydraulicspneumatics.com http://www.hpmag.co.uk http://www.www.janatics.com http://www.vickers.com http://www.festo.in http://www.www.yukenindia.com http://www.smcin.com http://www.www.polyhydron.com
Lecture No.	Topic/ Subtopic to be covered
1	Hydraulic Circuits Hydraulic symbols
2	Meter in, Meter out. Bleed off, Sequencing.
3	Introduction to electro-hydraulics – concept, principles and applications
4	Applications of hydraulic circuits – Hydraulic power steering, Hydraulic brakes,
5	Applications of hydraulic circuits milling machine, hydraulic press
6	Simple Pneumatic Circuits. Pneumatic symbols .Speed control circuit (Meter in, Meter out), Sequencing.
7	Applications of pneumatic circuits – Air brake, Low cost Automation in industries

8	Applications of pneumatic circuits –Low cost Automation in industries
9	Pneumatic power tools (drill, hammer, and grinder).
10	Comparison of Hydraulic and pneumatic circuits.

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:

Address a single theme at a time. Technical terms should be carefully explained. Give familiar examples and analogies, illustrations. Employ a variety of approaches. Implement method in which reading of books, periodicals, project or research papers are exercised. Allocate time limit for submission of assignment.

5.4 **Strategies for Conduct of Practical:**

5.4.1 Suggestions for effective conduct of practical and assessment:

- Teacher should read guidelines given in laboratory manual.
- He/she should also ask students to read instructions for students.
- Relate relevant personal experiences or events which have occurred in the work setting.
- Contribute ideas.
- Apply what have been learned to familiar situations for solving problems.
- Express what had been learned.
- Anticipate any difficult steps, possible interruptions e.t.c.
- Obtain all materials, tools, equipment, visual and teaching aids in advance and check their useful condition.
- Have all materials within reach and conveniently arranged.
- Remove all extraneous materials; check lighting, visibility, student grouping, and proximity to electric, gas and water outlets.
- Plan to use a method to work from simple to complex/known to unknown/whole to part.

5.4.3 Preparation for conduct of practical (Use of laboratory manual is mandatory)

- Make sure all students can see and hear the instructions.
- Be enthusiastic, professional, effective but not dramatic.
- Observe all safety rules and procedures.
- Keep demonstration smooth and continuous.
- Explain each step or process as you proceed.
- Make sure the student see the demonstration from the angle they will perform it themselves.
- Emphasize key points.
- Observe all safety rules, precautions and procedures; and emphasize them.
- Use proper instructions, aids such as chalkboard, charts, handouts e.t.c. to support your demonstration.
- Always summarize the steps and emphasize key points again.

AFTER DEMONSTRATION

- Make arrangements to have the students practice the skill as soon as possible in a practical session.
- Observe and analyze students' performance and correct mistakes.
- Offer reinforcement where necessary.
- Coach weak or slow students.
- Check students' completed work for accurate performance and record.
- Allow sufficient time interval before demonstrating another operation.

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

Roll No.				

17522

Institute Name:

Course Name: Diploma in Automobile Engineering Course Code: AE

Semester : **Fifth**

Subject**: Hydraulics & Pneumatics**

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

Q 1. Attempt any THREE. 09 Marks

a) What is priming? How it is done? Why it is necessary in Centrifugal pump.

b) Define steady flow, rotational flow and laminar flow

c) Define positive and negative slip.

d) Define atmospheric pressure, gauge pressure and absolute pressure.

Q 2. Attempt any TWO. 08 Marks

a) Write four parameters for selection of centrifugal pump.

b) With neat sketch, describe the construction of inverted U tube manometer.

c) Define steady, rotational, laminar and uniform flow.

Q 3. Attempt any ONE. 08 Marks

a) A oil of specific gravity 0.8 is flowing through Venturimeter having inlet diameter 20 cm and throat diameter is 10 cm. the differential manometer shows reading of 25 cm. calculate the discharge of oil through venturimeter. (take $C_d = 0.98$).

b) Explain construction and working of Double acting reciprocating pump with neat sketch.

Sample Test Paper II

Roll No.				

17522

Institute Name:

Course Name: Diploma in Automobile Engineering Course Code: AE

Semester : **Fifth**

Subject**: Hydraulics & Pneumatics**

Marks: **25** Time: **1 hour**

Instructions:

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

Q 1. Attempt any THREE. 09 Marks

a) Draw neat sketch of swash type pump and label it.

b) Explain construction and working of telescopic type hydraulic cylinder.

c) Compare filter and strainer any 3 points.

d) Write the type of hydraulic or pneumatic circuit used in following applications

i) Shaper machine ii) Latest Truck iii) Cars

Q 2. Attempt any TWO. 08 Marks

a) Draw symbols used in hydraulic circuit of pressure relief valve, unidirectional pump, 2/3 directional control valve, flow control valve.

b) Explain with neat sketch the principle on which hydraulic ram works.

c) Explain construction and working of piston type hydraulic motor.

Q 3. Attempt any ONE. **08 Marks**

a) Draw sequencing circuit for clamping and drilling operation.

b) i) Explain construction of any two types of connectors used pneumatic system with neat sketch.

ii) Give classification of valves.

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 intents 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.

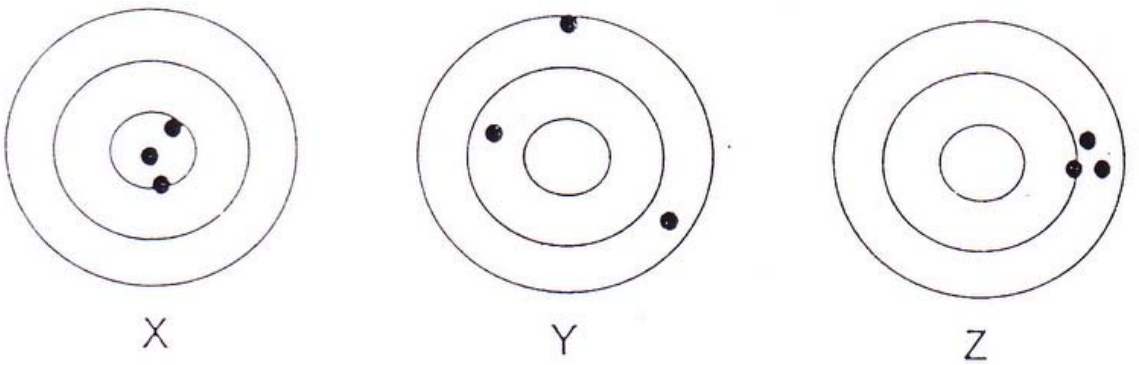
ii) **Examiners Objectivity**

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"



Reliable & Valid Shooting

Unreliable & Invalid Shooting

Reliable but invalid 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:

Exam Seat No.									

17522

Maharashtra State Board of Technical Education

Course Name: **Automobile Engineering** Course Code: AE

Semester: **Fifth**

Title of the Subject: Hydraulics and Pneumatics Subject Code: 17522

Marks: 100 Time: 03 Hrs

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

Q.1 A) Attempt any THREE of the following: 12 Marks

a) Define surface tension and capillarity.

b) Give classification of pneumatic valves.

c) Give classification of hydraulic actuators.

d) Write function of flexible hose. Write material used for different layers of flexible hose.

Q.1 B) Attempt any ONE of the following: 06 Marks

a) Describe with neat sketch Bourdon Tube pressure gauge.

b) Write construction and working of Double Acting Cylinder with neat sketch.

Q.2 Attempt any FOUR of the following: 16 Marks

a) Define all hydraulic coefficients.

b) State any two faults of centrifugal pump. Write two causes and two remedies of each.

c) Give any four reasons for cavitation in centrifugal pump.

d) Explain construction and working of Hydraulic jack with neat sketch.

e) Draw a neat labeled sketch of vane type pump.

Q.3 Attempt any FOUR of the following: 16 Marks

a) Compare gear pump and vane pump on the basis of construction, pressure, maintenance, cost

b) Explain construction and working of sliding spool type 3/2 direction control valve

c) Explain construction of Non return valve with neat sketch.

d) State two locations each, where seals and gaskets are used in hydraulic system.

e) Explain construction and working of proportional type filter with sketch.

Q.4 A) Attempt any THREE of the following: 12Marks

a) Explain construction and working of hydraulic press with sketch.

b) Explain construction and working of gear type air motor.

c) Draw neat sketch of quick action coupling and write its construction.

d) Draw a symbol for 4/3 direction control valve & FRL unit.

Q.4 B) Attempt any ONE of the following: 06 Marks

a) Draw layout of air brake system. Explain its working.

b) Compare hydraulic and pneumatic circuit on the basis of - Fluid used, Ease of operation, noise, speed, cost, application.

Q.5 Attempt any TWO of the following: 16 Marks

a) Derive an expression of discharge through venturimeter.

b) Compare reciprocating pump and centrifugal pump on the basis of construction, speed, discharge, pressure, efficiency, maintenance, cost, application.

c) Draw hydraulic circuit for milling machine and explain its working. State the type of circuit used.

Q.6 Attempt any TWO of the following: 16 Marks

a) A oil of specific gravity 0.8 is flowing through Venturimeter having inlet diameter 20 cm and throat diameter is 10 cm. the differential manometer shows reading of 25 cm. calculate the discharge of oil through venturimeter. (take $C_d = 0.98$).

b) Explain construction and working of centrifugal pump with neat sketch. Give its two applications.

c) Given hydraulic circuit is meter out type. Write the four corrections needed and reproduce the figure with all corrections incorporated. Label the figure.

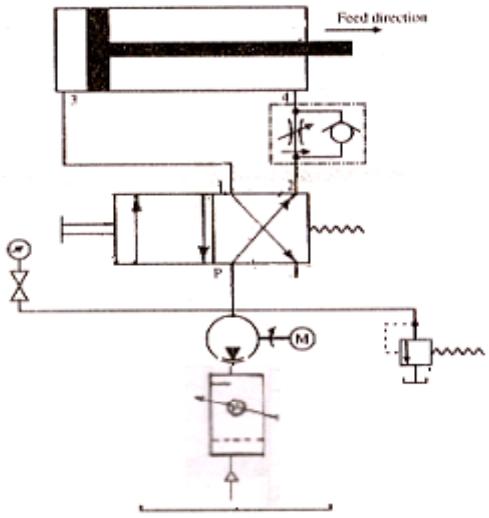


Figure 1

Marking Scheme for Sample Question Paper (17522)

Q. No.	Sub. Question	Bit	Distribution of Marks	Total Marks	Remarks
1	A	1	Definition 2 marks each	04	
		2	Classification: any 4 types. 1 mark each	04	
		3	Classification: any 4 types. 1 mark each	04	
		4	Function - 1 mark 3 layer material – 1 mark each.	04	
	B	1	Description 3 marks. Neat figure 2 marks. Labeling 1 mark.	06	
		2	Construction 2 marks. Working 2 marks Neat figure 2 marks.	06	
2		1	Definition 1mark each	04	
		2	2faults with 2 causes 2 remedies - 2 marks each	04	
		3	1 mark each	04	
		4	Construction 1marks. Working 1 marks Neat figure 2 marks.	04	
		5	Neat figure 3 marks. Labeling 1 mark.	04	
3		1	1 mark each	04	
		2	Construction 2 marks. Working 2 marks	04	
		3	Construction 2marks. Neat figure 2 marks.	04	
		4	2 Location of seals - 2 marks 2 Location of gaskets - 2 marks	04	
		5	Construction 1 marks. Working 1 marks Neat figure 2 marks	04	
4	A	1	Construction 1 marks. Working 1 marks Neat figure 2 marks	04	
		2	Construction 1 marks. Working 1 marks Neat figure 2 marks	04	

		3	Construction 2 marks. Neat figure 2 marks	04	
		4	2 marks each	04	
	B	1	Working - 3 marks Layout – 3 marks	06	
		2	1 mark each	06	
5		1	Diagram - 02 marks Application of Bernoulli's equation at section 1 & section 2 - 1mark each Finding Velocities – 1 mark each Final Expression – 2 marks	08	
		2	1 mark each	08	
		3	Working 3 marks Neat figure 3 marks Labeling 1 mark Type of circuit – 1mark.	08	
6		1	Difference of pressure head – 2mark Area calculation – 2 marks Formula of discharge – 1mark. Putting values & Final answer - 1mark. All Units – 2mark.	08	
		2	Construction 2 marks. Working 2 marks Neat figure 3 marks 2 Applications – 1mark.	08	
		3	Writing four corrections – 4 marks. Reproduction of figure – 2 mark. Labeling – 2mark.	08	