# CURRICULUM REVISION PROJECT

# 2014

## TEACHER GUIDE FOR

(Vehicle System Maintenance -17618)

## SIXTH SEMESTER AUTOMOBILE 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.

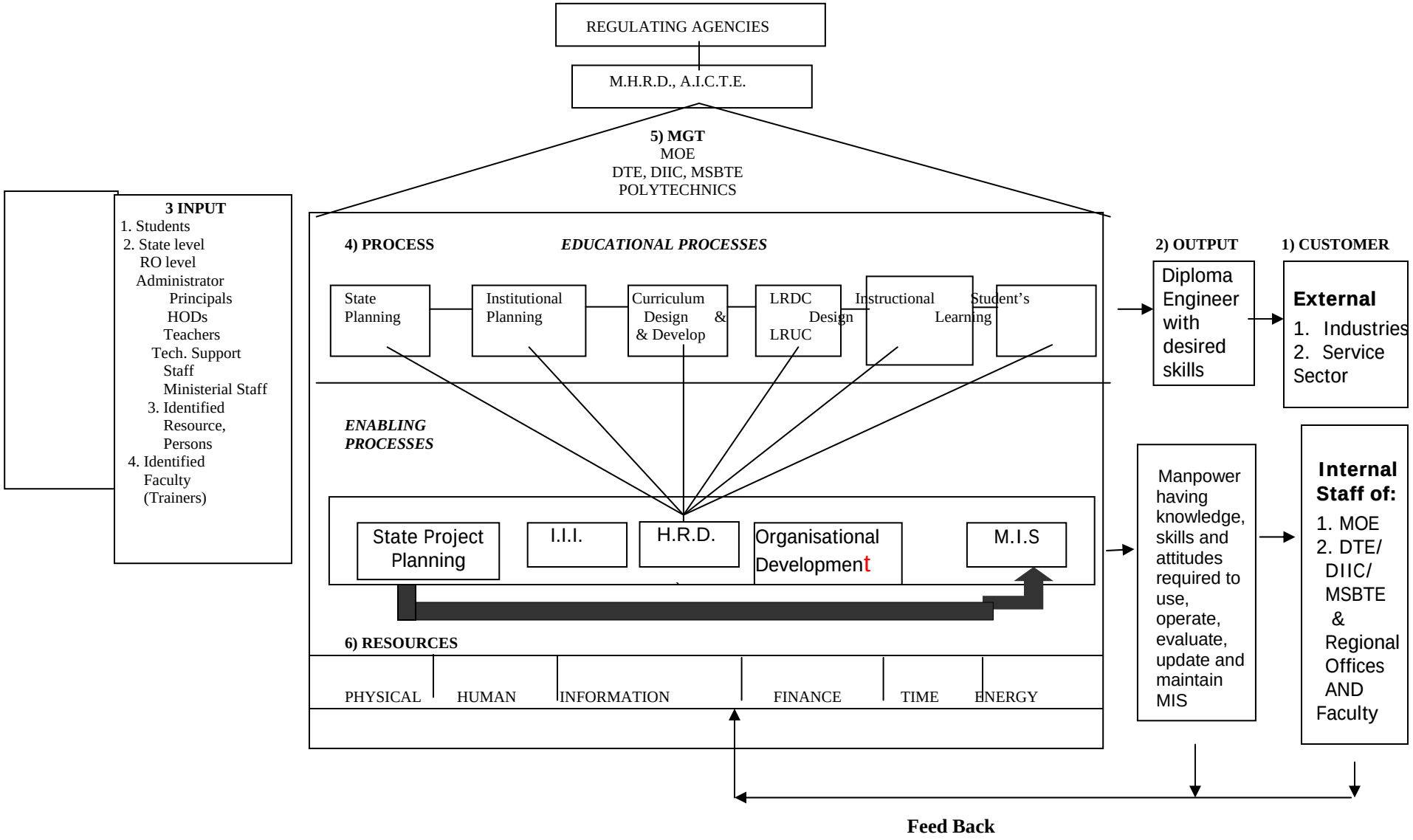



**Fig 1 Systems Approach**

## 1.4 Curriculum goals

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

**B) Motor Skills.**

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

## 1.6 Salient Changes in the curriculum:

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

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

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

# 2. OBJECTIVES

## 2.1 Introduction

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

## 2.2 Domains of Learning:

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

There are following domains of learning:

A: Cognitive Domain relates to intellectual skills or abilities

B: Affective Domain relates to emotions, feelings, likes, dislikes etc.

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

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

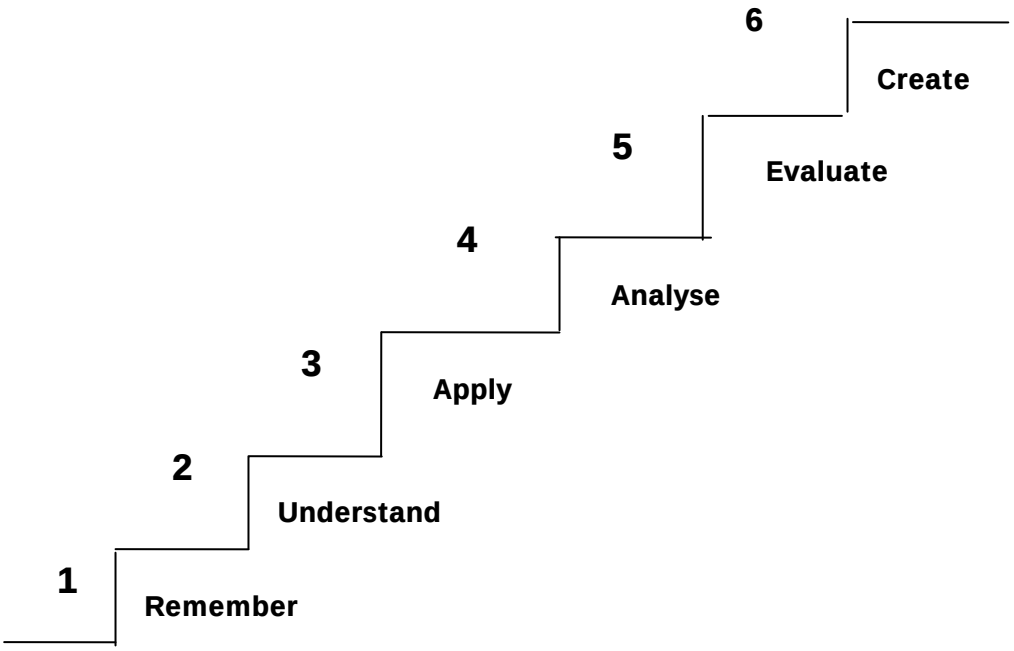
## 2.3 LEVELS OF LEARNING:

Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for the purpose of writing objectives and assessment. Dr. Bloom's revised taxonomy is based on cognitive psychology and is two dimensional. First dimension is cognitive process dimension 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 | Knows common terms, specific facts, basic concepts, principles, methods & procedures | Define, describe, identify label, list, match, name, outline, reproduce, select, |

| | | |
|---|---|---|
| to mind of the appropriate information. This represents the lowest level of learning outcomes in the cognitive domain | | 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 give direction to the student about how to study the subject, what important things are to be observed and performed during practicals.

Just as rationale indicates the use of the knowledge gained while 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 : Diploma in Automobile Engineering**

**Course Code : AE**

**Semester : Sixth**

**Subject Title : Vehicle Systems Maintenance**

**Subject Code : 17618**

**Teaching and Examination Scheme:**

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

**NOTE:**

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

**Rationale:**

Vehicle system maintenance is a core technology subject deals with automobile workshop, troubleshooting, servicing and repair of engine and related systems, transmission system, brake system, steering and suspension system etc. Prerequisites for this subject are automobile engines, advanced automobile engines, automobile transmission system and automobile systems which are studied adequately in previous semesters.

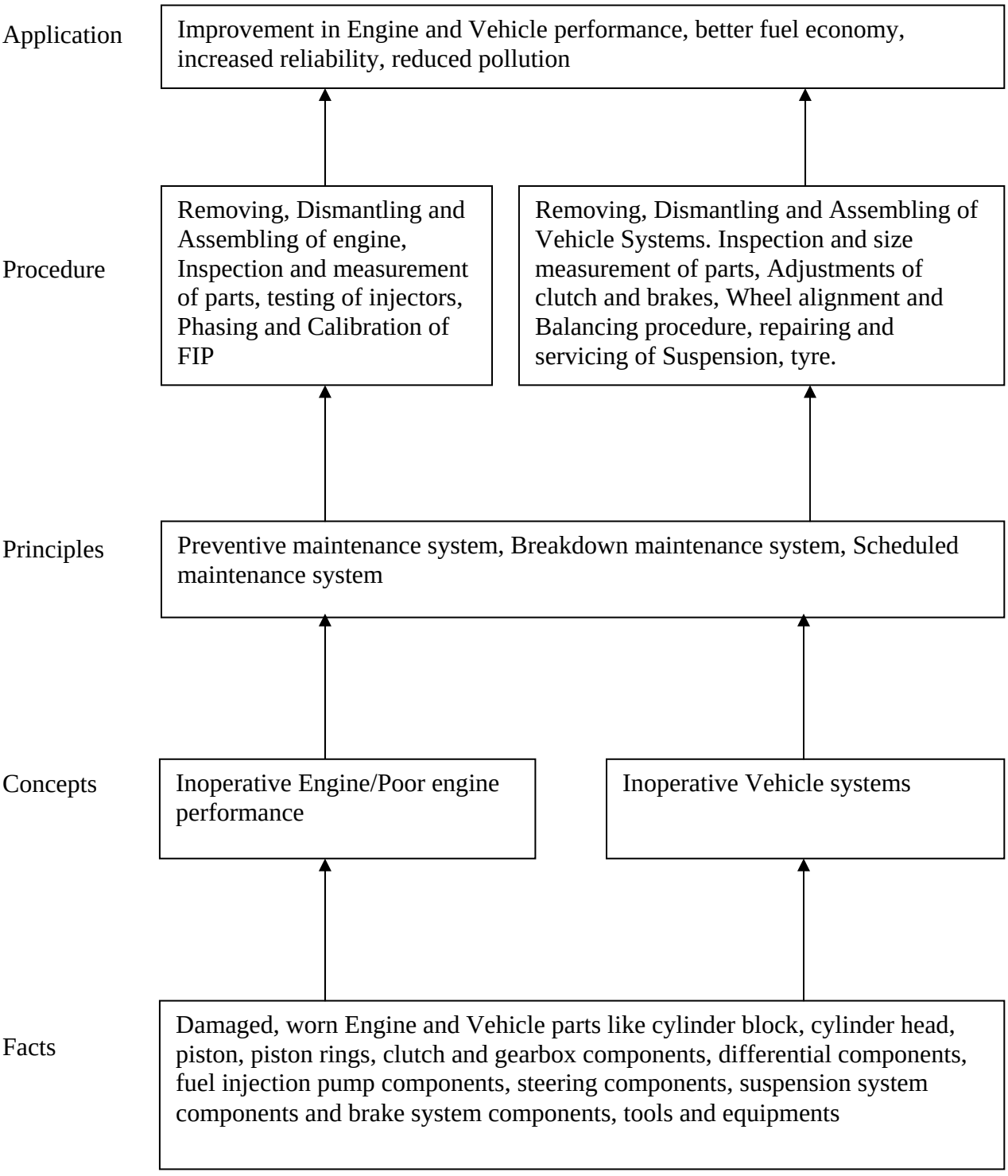
There is huge opportunity for diploma engineers in automobile service sector and entrepreneurship.

**General Objectives:**

The students will be able to:

1) Know the use of various workshop tools and equipments.
2) Draw layouts of automobile workshops, garages, and service stations.
3) Compare various types of maintenance systems.
4) Describe the general maintenance procedure.
5) Overhaul major components/assemblies and trouble shooting of various complaints.
6) Test and tune up of reassembled units/components.

**Learning Structure:**



**Theory:**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Auto Workshop Layout and Equipments**<br>**Specific Objectives:**<br>➢ Understand the use of different general purpose and special purpose tools and equipments required in workshops.<br>➢ Know safety precautions and procedures.<br>➢ Draw layouts of 2 and 4 wheeler service center, garage, modern workshop - carrying specialized repairs and list out required tools and equipments.<br>**Contents:**<br>1.1 Shop Equipments and Safety precautions<br>• General safety precautions and procedures.<br>• Functions of General shop equipments, gauges and tools with safety precautions while using:<br>Cylinder bore gauge, Inside and outside micrometer, dial indicator gauge, Straight edge and Feeler gauge, Torque wrench, Depth gauge, Wheel balancer, Wheel aligner, Crankshaft aligner and straightner, Engine analyzer, Arbor press, Tyre changer, FIP calibration machine, Head light aligner, Valve grinder, Cylinder boring, Honing machine.<br>1.2 Workshop Layouts:-<br>• Layout with equipments required for dealers of two wheeler, four wheelers- cars and commercial vehicles and for road- side garage.<br>• Layout of modern workshop for specialized job work like crankshaft repair, engine cylinder re-boring, F.I.P testing and repair, brake drum boring. Wheel balancing and alignment, Dent and paint shop etc. | 08 | 14 |
| **Topic 2: Maintenance Management and Record Keeping**<br>**Specific Objectives:**<br>➢ Understand necessity and types of maintenance, write maintenance schedule<br>➢ Keep the maintenance records.<br>**Contents:**<br>2.1 Maintenance Management<br>• Necessity of maintenance<br>• Types of maintenance and their applications - Preventive maintenance system, Scheduled maintenance system, Break down maintenance system<br>• General maintenance schedule –on time/day basis or kilometers traveled basis for Two wheelers, Light Motor Vehicle, Heavy Motor Vehicle<br>• General servicing procedure. Decision to repair or replace.<br>2.2 Record Keeping<br>• Workshop records and their importance - History sheet, Work orders and activity file only. | 07 | 12 |
| **Topic 3: Engine Maintenance**<br>**Specific Objectives:**<br>➢ Identify the complaints, write their causes, remedies of engine and engine systems.<br>➢ Know and perform engine tune up. | | |

| | | |
|---|---|---|
| ➢ Perform the servicing of fuel, lubrication and cooling system components.<br>**Contents:**<br>**Part A: Engine diagnosis, Servicing and trouble shooting 20 Marks**<br><br>3.1 Engine Diagnosis- Engine Smoke, oil level and condition, coolant level and condition, oil pressure testing, compression test, vacuum test, Cylinder Leakage test.<br>3.2 Engine Servicing<br>• Checking and Servicing of engine components: cylinder head, cylinder block, cylinder liners, piston, piston ring, crank-shaft, Connecting rod, valves.<br>• Tuning of engine.<br>3.3 Troubles, Causes and remedies in fuel, cooling, lubrication system and MPFI Engine, charging and starting system.<br>**Part B: Fuel, Lubrication and Cooling systems servicing 18 Marks**<br><br>3.4 Fuel feed system service, carburetor - dismantling, cleaning and tuning. Injector cleaning and testing, FIP phasing and calibration, CRDI injector servicing, MPFI -injector testing and cleaning.<br>3.5 Lubrication system service. – change oil filter, check oil pump, and diagnose causes for excessive oil consumption, external oil leakage, and low oil pressure in an engine.<br>3.6 Cooling system servicing - refilling of radiator, Pressure testing, thermostat checking, Leakage testing, Fan belt tension checking and adjusting. | 14<br><br>12 | 20<br><br>18 |
| **Topic 4: Transmission System Maintenance**<br>**Specific Objectives:**<br>➢ Identify faults in transmission system.<br>➢ Carry-out maintenance to rectify the faults<br>**Contents:**<br>4.1 Maintenance of Clutch and Gearbox<br>• Checking clutch plate for thickness, run out, rivet depth, slackness of torsion spring. Pressure plate surface and thickness, axial spring height.<br>• Clutch adjustment – types and procedure.<br>• Clutch troubleshooting – causes and remedies<br>• Checking gearbox for run out of main shaft and lay shaft, oil seals, bearings, gears and synchromesh unit.<br>• Gearbox Troubleshooting- causes and remedies.<br>4.2 Maintenance of Final drive, Propeller shaft and rear axle.<br>• Checking and adjusting differential for ring gear run-out, backlash in ring gear, tooth contact between ring gear and pinion, bearing preload – necessity and procedure.<br>• Troubles, Causes and remedies of propeller shaft, differential and rear axle. | 10 | 16 |
| **Topic 5: System and Body Maintenance**<br>**Specific Objectives:**<br>➢ Identify faults in suspension, steering and braking system.<br>➢ Carry-out maintenance to rectify the faults<br>➢ Describe repair methods of body and repainting.<br>➢ Identify painting defects and describe their causes and remedies. | 13 | 20 |

| | | |
|---|---|---|
| **Contents:**<br>5.1 Maintenance of Brakes<br>• Inspection of master cylinder, wheel cylinder, brake drum, brake linings, brake disc and brake pads.<br>• Adjustment of hydraulic brakes – shoe clearance, brake pedal free travel, pedal to floor clearance, parking brake adjustment.<br>• Procedure of bleeding of hydraulic brakes. Types of brake bleeding.<br>• Troubles, Causes and remedies of Hydraulic and Air brake system.<br>5.2 Troubleshooting of suspension and Steering system<br>• Troubles, causes and remedies of suspension system,<br>• Troubles, causes and remedies of steering System.<br>5.3 Maintenance of wheels and tyres<br>• Care of wheels and tyres,<br>• Procedure of tyre retreading and vulcanizing.<br>• Procedure of wheel alignment by wheel alignment gauges and procedure of wheel balancing.<br>5.4 Frame and Body repair<br>• Frame repairs (for cracks, loose rivets, and skewness in frames) and alignments.<br>• Body repairs- Procedure to remove dent, denting tools and equipments.<br>• Adjustment of doors and locks.<br>• Repainting procedure, patch work. Painting defects. | | |
| **Total** | **64** | **100** |

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

**Intellectual Skills**:

1. Select tool and equipment for vehicle maintenance.
2. Diagnose faults and suggest remedies.
3. Understand tuning, backlash.

**Motor Skills:**

1. Put vehicle on the ramp
2. Use diagnostic tester
3. Use service manuals for maintenance of vehicle.

**List of Practicals:**

| Sr. No | List of Practical |
|---|---|
| 01 | Observe and list various tools, machine equipments used in garage / workshops - write their function and precautions while handling. |
| 02 | Remove multi-cylinder engine from a vehicle, dismantle, clean, inspects, and write causes and repair procedure of following components.<br>a) Cylinder head for warpage and cracks, refacing by grinding or cutting, straightening cylinder heads<br>b) Cylinder block for measurement of ovality and taper, cylinder boring, honing process, changing of liners. |

| | |
|---|---|
| | c) Piston and piston rings for wear, appearance, and piston head for signs of deposits, over size piston, ring groove clearance, piston ring end gap, removing and refitting rings. |
| 03 | Tuning of carburetor. |
| 04 | Dismantle and do maintenance of Diesel fuel injection pump and fuel injector. |
| 05 | Servicing lubrication system- change oil filter, check oil pump, diagnose causes for excessive consumption, external oil leakage, and low oil pressure in an automobile engine. |
| 06 | To dismantle, overhaul and assemble a single plate clutch assembly. |
| 07 | Dismantle, overhaul and assemble a synchromesh gearbox of a vehicle. |
| 08 | Dismantle the propeller shaft and differential. Check wear in universal joint and slip joint, straightness in propeller shaft, remove bushes and bearing and reassemble it. Check the differential gears for wear, run out, backlash, and tooth contact. Write procedure to adjust the final drive for obtaining even tooth contact. |
| 09 | Dismantle and write procedure of adjustment of mechanical and hydraulic brakes and renewal of brake liners, repairing of master cylinder, wheel cylinder, brake chamber, brake bleeding, skimming scored brake drum. |
| 10 | Remove and refit the steering linkage and gearbox. Removing and installing of ball joints. Adjust backlash in steering gears. Adjust steering column end play and write procedure. |

**Learning Resources:**

1. **Books:**

| Sr. No. | Author | Title | Publisher |
|---|---|---|---|
| 01 | Tim Gills | Automotive Service | Delmar Publisher Inc. |
| 02 | Crouse / Anglin. | Automobile Mechanics | TATA McGraw – HILL |
| 03 | James Halderman | Automotive Engines- Theory and Servicing | Pearson Education |
| 04 | Anil Chikara | Automobile Engineering (Vol. III, IV and V) | Satya Prakashan, New Delhi |
| 05 | Anthony Schwaller | Motor Automotive Technology | Delmar Publisher Inc. |
| 06 | Ken Layne | Automotive Engine Performance | Prentice Hall Career Technology |
| 07 | Ian Norman, Robert Scharff, John Corinchoke | Heavy Duty Truck System | Delmar Publisher Inc. |
| 08 | -- | Santro and Accent Basic training Book | Hyundai Motors India Ltd |
| 09 | -- | Service Manuals of Euro-II Vehicles. | Maruti motors India Ltd. |

2. **CDs, PPTs Etc.:**
   - CAI Package- Experiments in Automobile Garage Practice, developed by MSBTE.

3. **Websites:**

www.howstuffworks.com , www.youtube.com
www.nptel.com , www.npkauto.com

### 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:

| Sr. No. | Phase | Events | Time to be allotted |
|---|---|---|---|
| 1. | Introduction | • Recall of Prerequisites.<br>• Linking of previous knowledge with the new topic.<br>• Creating interest among the students. | 5 to 10 Minutes |
| 2. | Development | • Content Delivery<br>(should be such that the interest should be created & sustained among the students)<br>• Giving analogy for the abstract concepts.<br>• Giving examples from the world of work.<br>• Solving numerical problems.<br>• Asking questions to the students.<br>• Involving students in the teaching learning process. | 40 to 50 Minutes |
| 3. | Consolidation | • Summarizing the lecture.<br>• Creating curiosity among the students about the next lecture | 5 to 10 Minutes |

## 5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic I

Name**: Auto Workshop Layout and Equipments**

**Objectives:**

- Understand the use of different general purpose and special purpose tools and equipments required in automobile workshops.
- Know safety precautions and procedures while handling tools and equipments.
- Draw layouts of 2 and 4 wheeler service center, garage, modern workshop - carrying specialized repairs and list out required tools and equipments.
- Know about generalized workshop and specialized workshop and particular works carrying in workshops.

| Knowledge Category | Example/s of category | Teaching methodology |
|---|---|---|
| **FACT** | **General Workshop tools, special tools, equipments, measurements**<br>**General arrangement of a typical garage** | Explanation with chalk & board initially. Make use of charts/ working models and also show the general, special tools and workshop equipments available in laboratory for better understanding of students. |
| **CONCEPT** | **Leverage, friction, torques Fits, ergonomics, productivity, pneumatics, calibration, measurements, machining.** | Explanation of concept with chalk & board initially. Show schematic diagrams, ppts, working models or animations/ videos on U-tube for better understanding of students. |
| **PRINCIPLE** | **Friction force and clamping force of bolts, alignment and calibration. Principle of work flow and material handling.** | Explanation with PPT, and animation explain need of tools and layout arrangements |
| **PROCEDURE** | **Torquing of bolts, fitments of bearing, seals, alignment procedure different service procedures** | Explanation with chalk & board initially. Demonstrate the details of equipments through models and PPT. |
| **APPLICATION** | **Tools and Equipments use. Workshop layout for 2 wheeler , 4 wheeler and Specialized workshop** | Explanation with chalk & board initially. Show charts, working models, PPT and Video clips available on U-tube for better understanding of students. |

Learning Resources: Books , Charts ,Models and PPTs

Books: 1) Dr. Kripal Singh- Automobile engine Vol.2

| | |
|---|---|
| | Title 2) Anil Chikara- Automobile engineering Vol.3<br>3) R.B.Gupta- Automobile engineering<br>4) K.K.Ramlingam- Automobile engineering<br><br>**Teaching Aids:** Charts of general and special tools, workshop equipments, and workshop layout.<br><br>**PPTs:** Tools, Workshop equipments and workshop layout of a typical Two wheeler and four wheeler service station.<br><br>**Websites: -** on the following websites referred for the information related to tools and equipments, its animations and operational videos.<br>**www.howstuffworks.com**<br>**www.youtube.com**<br>**www.npkauto.com** |
| Lecture No. | Topic/ Subtopic to be covered |
| 1 | **Need of tools and equipments. General applied mechanics principles.**<br>Shop Equipments and Safety precautions explain with examples, showing tools or its ppt<br>General safety precautions and procedures<br>Show students a small spanner and big spanner and ask question about why big spanner is long? What is leverage?<br>**use following links for General tools**<br>https://www.youtube.com/watch?v=RU-BTQ5E9Vo<br>https://www.youtube.com/watch?v=GBwvgZ3lLCs |
| 2 | Functions of General gauges and tools with safety precautions while using<br>Cylinder bore gauge, Inside and outside micrometer, dial indicator gauge, Straight edge and Feeler gauge, Torque wrench, Depth gauge, |
| 3 | Functions of General shop equipments with safety precautions while using:<br>Wheel balancer, Wheel aligner, Crankshaft aligner and straightner.<br>**Use following links for Wheel alignment**<br>https://www.youtube.com/watch?v=lADVUgJpZXA |
| 4 | Functions of General shop equipments with safety precautions while using:<br>Engine analyzer, Arbor press, Tire changer, FIP calibration machine |
| 5 | Functions of General shop equipments with safety Precautions while using:<br>Head light aligner, Valve grinder, Cylinder boring, Honing machine. |
| 6 | Workshop Layouts: - Need of a layout. For layout give suitable example for arrangement of available space<br>Layout with equipments required for dealers of two wheeler, four wheelers- cars and commercial vehicles and for road- side garage.<br>**Use following Link for Layout**<br>https://www.youtube.com/watch?v=ccWQaL3LBCk |
| 7 | Layout of modern workshop for specialized job work like crankshaft repair, engine cylinder re-boring, F.I.P testing and repair, brake drum boring. Wheel balancing and alignment, Dent and paint shop etc |
| 8 | Applications and review |
| | **Name: Maintenance Management and Record Keeping**<br>**Objectives:** |

Topic 2

- ❖ Understand the necessity and types of maintenance, write or prepare maintenance schedule and general servicing procedure
- ❖ Decision related to repair or replace
- ❖ Keep the maintenance records

| Knowledge Category | Example/s of category | Teaching methodology |
|---|---|---|
| **FACT** | **Underperforming or Undue failure of components and history sheet** | Explanation with chalk & board initially. Performance parameters of a vehicle. Also make use of Charts/PPTs for better understanding of students. |
| **CONCEPT** | **Performance of vehicle and components life.** | Explanation with chalk & board initially. Make use of Charts/PPTs of component. Explain the, concept of performance and life of a vehicle |
| **PRINCIPLE** | **Wear, fatigue.** | Explanation with chalk & board initially. Explain with a video the concept of fatigue. |
| **PROCEDURE** | **Maintenance management and importance of record keeping** | Explanation with chalk & board initially. Show charts pictures, PPTs and animations to the students for better understanding. |
| **APPLICATION** | **Maintenance of two, four wheelers and heavy vehicle and related records like job card, activity file and history sheet.** | Explanation with chalk & board initially. Explain maintenance procedure through with video show service schedule of a car and two wheeler for better understanding of students. |

<table>
<tr><td></td><td>Learning Resources: Learning Resources: Books , Charts ,Models and PPTs<br><br>Books: 1) Dr. Kripal Singh- Automobile engine Vol.2<br>Title 2) Anil Chikara- Automobile engineering Vol.1<br>3) R.B.Gupta- Automobile engineering<br>4) K.K.Ramlingam- Automobile engineering<br>5) P.C.Sharma- Production technology<br>65) R.K.Jain – production technology<br><br>Teaching Aids: Charts of engine component, Cut section models of 2-Stroke and 4-Stroke Engine, Working model of valve mechanism and model or chart of chain drive and belt drive.<br><br>PPT with Sample: Engine assembly, Valve mechanisms, valve and port timing diagram.<br><br>Websites:<br>www.howstuffworks.com<br>www.youtube.com<br>www.npkauto.com</td></tr>
<tr><td>Lecture No.</td><td>Topic/ Subtopic to be covered</td></tr>
<tr><td>1</td><td>Necessity of maintenance give suitable example of ignorers of maintenance what will happens Types of maintenance</td></tr>
<tr><td>2</td><td>Explain concept of Preventive maintenance system, Scheduled maintenance system.</td></tr>
<tr><td>3</td><td>Types of maintenance and their applications : Break down maintenance system</td></tr>
<tr><td>4</td><td>General maintenance schedule –on time/day basis or kilometers traveled basis for Two wheelers</td></tr>
<tr><td>5</td><td>General maintenance schedule – Light Motor Vehicle, Heavy Motor Vehicle</td></tr>
<tr><td>6</td><td>General servicing procedure. Decision to repair or replace</td></tr>
<tr><td>7</td><td>Workshop records and their importance - History sheet, Work orders and activity file only.</td></tr>
<tr><td>Topic 3</td><td>Name: Engine Maintenance.<br>Objectives:<br>❖ Identify the complaints, write their causes, remedies of engine and engine systems.<br>❖ Know and perform engine tune up.<br>❖ Perform the servicing of fuel, lubrication and cooling system components.<br><br>
<table>
<tr><th>Knowledge Category</th><th>Example/s of category</th><th>Teaching methodology</th></tr>
<tr><td>FACT</td><td>Engine and its components like piston ,piston rings connecting rod crank shaft and systems like cooling ignition lubrication</td><td>Explanation with chalk & board initially. Show the different materials and components and explain their role in the system.</td></tr>
<tr><td>CONCEPT</td><td>Engine performance</td><td>Explanation with chalk & board initially. Explain interrelationship of these</td></tr>
</table>
</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | | concepts on black board. |
| | **PRINCIPLE** | **Wear and failure** | Explanation with chalk & board initially show video and photographs for understanding. |
| | **PROCEDURE** | **Engine fault diagnosis and engine systems fault diagnosis** | Explanation with chalk & board initially. Demonstrate through models, PPT and schematic diagram for better understanding. |
| | **APPLICATION** | **Engine fault diagnosis of petrol and diesel engines (Euro 3, Euro 4 and Euro 5) and related Bharat Stage norms** | Explanation with chalk & board initially. Show working models, cut section models charts, PPT and Video clips for better understanding. |

Learning Resources: Books , Charts ,Models and PPTs

**Books**: 1) Dr. Kripal Singh- Automobile engine Vol.2
**Title** 2) Anil Chikara- Automobile engineering Vol.1
3) R.B.Gupta- Automobile engineering
4) K.K.Ramlingam- Automobile engineering

**Teaching Aids:** Charts of PV diagrams, Cut section models of 2-Stroke and 4-Stroke Engine. Animations of operation cycles.

**PPTs:** Engine nomenclature, Comparison, classification, specification of engines.

**Websites :-**
**www.howstuffworks.com**
**www.youtube.com**
**www.npkauto.com**

| Lecture No. | Topic/ Subtopic to be covered |
|---|---|
| 1 | Engine Diagnosis- Necessity and importance<br>Engine Smoke, oil level and condition, coolant level and condition with procedure |
| 2 | Engine Diagnosis- Oil pressure testing, compression test with procedure |
| 3 | Engine Diagnosis- Vacuum test, Cylinder Leakage test with procedure |
| 4 | Engine Servicing<br>Checking and Servicing of engine components: cylinder head with procedures, precautions and necessary operations |
| 5 | Engine Servicing<br>Checking and servicing of engine components like cylinder block, cylinder liners with procedures, precautions and necessary operations |
| 6 | Engine Servicing<br>Piston, piston ring, crank-shaft, Connecting rod, valves. |
| 7 | Troubles, Causes and remedies in fuel, cooling, lubrication system and<br>MPFI Engine, charging and starting system. |

| | |
|---|---|
| 8 | Engine Servicing<br>Engine tune up procedure for Petrol engine |
| 9 | Engine tune up procedure for Diesel engine |
| 10 | Troubles, Causes and remedies in fuel system |
| 11 | Troubles, Causes and remedies in engine cooling systems |
| 12 | Troubles, Causes and remedies in lubrication system and MPFI Engine |
| 13 | Troubles, Causes and remedies in MPFI Engine |
| 14 | Troubles, Causes and remedies in charging and starting system |
| 15 ,16 and 17 | Fuel feed system service, carburetor - dismantling, cleaning and tuning with procedure<br>Injector dismantling ,cleaning and testing with procedure |
| 18 | Fuel feed system service : FIP phasing and calibration with procedure |
| 19,20 and 21 | CRDI injector servicing testing and cleaning<br>MPFI -injector testing and cleaning |
| 22 and 23 | Lubrication system service. – Inspection and checking condition of oil filter, oil pump<br>Diagnose causes for excessive oil consumption, external oil leakage, and low oil pressure in an engine |
| 24 | Cooling system servicing - refilling of radiator, Pressure testing, thermostat checking, |
| 25 | Leakage testing, Fan belt tension checking and adjusting |
| 26 | Overview |
| Topic 4 | Name**: Transmission System Maintenance**<br>**Objectives:**<br>❖ Identify faults in transmission system.<br>❖ Carry-out maintenance to rectify the faults. |

| **Knowledge Category** | **Example/s of category** | **Teaching methodology** |
|---|---|---|
| **FACT** | **Transmission system and its components like gearbox, clutch propeller shaft final drive rear axle** | Explanation with chalk & board initially. Show the actual components in class room and explain their role in system. Make use of charts and figure for better understanding. |
| **CONCEPT** | **Performance of transmission system** | Explanation with chalk & board initially with schematic diagram. Also show the animation of it. |
| **PRINCIPLE** | **Friction, wear, fatigue ,corrosion and life** | Explanation with chalk & board initially. State its applications in practical field. |
| **PROCEDURE** | **Schedule maintenance and brake down maintenance of transmission system and its components** | Explanation with chalk & board initially Demonstrate through models, PPT and schematic diagram on black board |
| **APPLICATION** | **4 wheeler and heavy** | Explanation with chalk |

| | | | |
|---|---|---|---|
| | | **vehicle transmission systems and its trouble shooting** | & board initially, Show charts, PPT and Video clips for better understanding. |

Learning Resources: Books , Charts ,Models and PPTs

**Books**: 1) Dr. Kripal Singh- Automobile engine Vol.2
**Title** 2) Anil Chikara- Automobile engineering Vol.1
3) R.B.Gupta- Automobile engineering
4) K.K.Ramlingam- Automobile engineering

**Teaching Aids:** Charts of PV diagrams, Cut section models of 2-Stroke and 4-Stroke Engine. Animations of operation cycles.

**PPTs:** Battery ignition system, magneto ignition system, firing order of engine and exhaust system.

**Websites :-**
**www.howstuffworks.com**
**www.youtube.com**
**www.npkauto.com**

| Lecture No. | Topic/ Subtopic to be covered |
|---|---|
| 1 | Necessity and importance and Overview of working and performance of clutch and gearbox |
| 2 | Maintenance of Clutch and Gearbox<br>Checking clutch plate for thickness, run out, rivet depth, slackness of torsion spring. Pressure plate surface and thickness, axial spring height with procedure |
| 3 | Maintenance of Clutch and Gearbox<br>Clutch adjustment – types and procedure |
| 4 | Clutch troubleshooting – causes and remedies |
| 5 | Gearbox Troubleshooting- causes and remedies |
| 6 and 7 | Maintenance of Final drive, Checking and adjusting differential for ring gear run-out, backlash in ring gear |
| 8 | Tooth contact between ring gear and pinion, bearing preload – necessity and procedure. |
| 9 | Troubles, Causes and remedies of propeller shaft, differential |
| 10 | Troubles, Causes and remedies of rear axle |

Topic 5 Name**: System and Body Maintenance.**

Objectives:

- ❖ Identify faults in suspension, steering and braking system.
- ❖ Carry-out maintenance to rectify the faults
- ❖ Describe repair methods of body and repainting.
- ❖ Identify painting defects and describe their causes and remedies.

| **Knowledge Category** | **Example/s of category** | **Teaching methodology** |
|---|---|---|
| **FACT** | **Brake systems, steering system and suspension** | Explanation with chalk & board initially, Show |

| | | |
|---|---|---|
| | **system , frames, body, wheels and tires** | the various components of engine cooling and lubrication system in class room and explain their role in system. Explain with schematic diagram better understanding. |
| **CONCEPT** | **Wearing phenomenon, vehicle control and safety** | Explanation with chalk & board initially, Explain relevance of these concepts from engine performance point of view. |
| **PRINCIPLE** | **Friction, wear, fatigue ,corrosion** | Explanation with chalk & board initially, Explain with figures and animation for better understanding. |
| **PROCEDURE** | **Schedule maintenance and brake down maintenance of brake system, steering system, suspension, body and frame** | Explanation with chalk & board initially, Show the pictures, PPTs and animations for better understanding. |
| **APPLICATION** | **Cars and HCV control systems and body maintenance.** | Explanation with chalk & board initially, Show the picture, PPTs, working models or animations available on U-tube for better understanding. |

Learning Resources: Learning Resources: Books , Charts ,Models and PPTs

| | |
|---|---|
| | Books: 1) Dr. Kripal Singh- Automobile engine Vol.2<br>Title 2) Anil Chikara- Automobile engineering Vol.1<br>3) R.B.Gupta- Automobile engineering<br>4) K.K.Ramlingam- Automobile engineering<br><br>**Teaching Aids:** Charts of engine cooling and lubrication system, Components of cooling and lubrication system.<br><br>**PPT with Sample**: Engine cooling and lubrication system<br><br>**Websites:**<br>**www.howstuffworks.com**<br>**www.youtube.com**<br>**www.npkauto.com** |
| Lecture No. | Topic/ Subtopic to be covered |
| 1 | Maintenance of Brakes :Necessity and importance<br>Inspection of master cylinder, wheel cylinder with procedure |
| 2 | Maintenance of brake drum, brake linings, brake disc and brake pads with procedure |
| 3 | Adjustment of hydraulic brakes – shoe clearance, brake pedal free travel, pedal to floor clearance, parking brake adjustment with detailed procedure |
| 4 | Types of brake bleeding. Procedure of bleeding of hydraulic brakes. |
| 5 | Troubles, Causes and remedies of Hydraulic and Air brake system |
| 6 | Troubleshooting of suspension and Steering system<br>Troubles, causes and remedies of suspension system, |
| 7 | Troubleshooting of suspension and Steering system<br>Troubles, causes and remedies of steering System. |
| 9 | Maintenance of wheels and tyres<br>Care of wheels and tyres, Tyre rotation necessity and procedure |
| 10 | Procedure of tyre retreading and vulcanizing.<br>Procedure of wheel alignment by wheel alignment gauges<br>Procedure of wheel balancing |
| 11 | Frame and Body repair<br>Frame repairs (for cracks, loose rivets, and skewness in frames) and Alignments.<br>Procedure |
| 12 | Body repairs- Procedure to remove dent, denting tools and equipments. |
| 13 | Adjustment of doors and locks.<br>Repainting procedure, patch work. Painting defects. |

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:**

Teacher should give assignment on each topic covered. Assignment should based on MSBTE Curriculum.

5.4 **Strategies for Conduct of Practical:**

5.4.1 Suggestions for effective conduct of practical:

**Note**

**1.** Practicals may be performed in a group of 4 to 6 students.

2. Engines, transmission systems, control systems and suspension systems are dismantle, Observations and inspections, taking measurements may be performed by the batch.

3. Arrange workshop visits for students for observe the maintenance work such as in ST Depot or MSRTC Divisional workshop, Dealer or Authorized service station layout, Wheel alignment, wheel balancing, FIP calibration test bench, Tire changer etc. Denting and painting sections etc.

**5.4.2 Preparation for conduct of practical**

Working models, cut section models, tools, components of various systems should be a kept ready for practical. Some maintenance videos or exploded animations of particular system should be shown to students for better understanding.

| Sr. No | List of Practical |
|---|---|
| 01 | **Title**: Observe and list various tools, machine equipments used in garage / workshops - write their function and precautions while handling.<br><br>**Conduction of Practical:**<br>Prepare the two groups of students ask questions on the types of tools, machine equipments used in garage.<br>**Equipments and tools required**: Spanner sets- open ended, ring spanner, combination type, and box type. Screw drivers- plain and star type with magnetic tip, wrenches sets- adjustable type nose type. Torque wrenches- dial gauge type, adjustable type etc., Allen key sets, Feeler gauge, Vernier caliper, Micrometer- Inside and Outside type, Dial indicator gauge, Bore gauge, Compression tester – Petrol engine, Diesel engine. Vacuum tester, Hydrometer, Battery Cell tester, Neon timing light gun, Bearing puller, Piston ring compressor and expander, Grease gun, Punches , Impact screw driver. Tacho meter mechanical and digital type, Fuel filter remover, Spark plug remover, Creeper, Hydraulic and screw jacks etc.<br>**Procedures:** Show all the tools mention in above list and explain its function and their application. Explain safety precautions and handling procedures. Instructions related to measuring instruments. |
| 02 | Remove multi-cylinder engine from a vehicle, dismantle, clean, inspects, and write causes and repair procedure of following components.<br>d) Cylinder head for warpage and cracks, refacing by grinding or cutting, straightening cylinder heads<br>e) Cylinder block for measurement of ovality and taper, cylinder boring, honing process, changing of liners.<br>f) Piston and piston rings for wear, appearance, and piston head for signs of deposits, over size piston, ring groove clearance, piston ring end gap, removing and refitting rings. |
| 03 | Tuning of carburetor. |
| 04 | Dismantle and do maintenance of Diesel fuel injection pump and fuel injector. |
| 05 | Servicing lubrication system- change oil filter, check oil pump, diagnose causes for excessive consumption, external oil leakage, and low oil pressure in an automobile engine. |
| 06 | To dismantle, overhaul and assemble a single plate clutch assembly. |
| 07 | Dismantle, overhaul and assemble a synchromesh gearbox of a vehicle. |
| 08 | Dismantle the propeller shaft and differential. Check wear in universal joint and slip joint, straightness in propeller shaft, remove bushes and bearing and reassemble it. Check the differential gears for wear, run out, backlash, and tooth contact. Write procedure to adjust the final drive for obtaining even tooth contact. |
| 09 | Dismantle and write procedure of adjustment of mechanical and hydraulic brakes and renewal of brake liners, repairing of master cylinder, wheel cylinder, brake chamber, brake bleeding, skimming scored brake drum. |
| 10 | Remove and refit the steering linkage and gearbox. Removing and installing of ball joints. Adjust backlash in steering gears. Adjust steering column end play and write procedure. |

**6.**

**Mode of assessment:**

1.1 Class Test:

ach 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 paper

| **Roll No.** | | | | |
|---|---|---|---|---|

Subject Code

**17618**

**Course Name: Automobile Engineering**

**Course Code : AE**

**Semester : Sixth**

**Subject : Vehicle System Maintenance**

**Marks : 25** **Time: 1 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.

---

**Q.1 Attempt any Three of the following** **09 Marks**

a) List the general tools required for garage. (Any six)

b) State the function of

i) Cylinder bore gauge ii) Engine analyzer iii) Torque wrench

c) What is the necessity of maintenance? List types of maintenance.

d) What is the importance of vehicle history sheet in auto workshop?

**Q.2 Attempt any TWO of the following** **08 Marks**

a) Draw the layout required for Two Wheeler dealers workshop to sell 150 vehicles per Month. Show the garage facilities which are necessary.

b) Differentiate between preventive maintenance and breakdown maintenance.

c) Write at least four causes and remedies for engine overheating.

**Q.3 Attempt any TWO of the following** **08 Marks**

a) Engine emits blue smoke. - Suggest probable causes and its remedies.

b) Write the procedure for checking cylinder block.

c) State at least four causes and its remedies for engine developing less power.

**Sample Test Paper 2**

| **Roll No.** | | | | |
|---|---|---|---|---|

Subject Code

**17618**

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

**Subject : Vehicle System Maintenance**
**Marks : 25** **Time: 1 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.

---

**Q.1 Attempt any Three of the following** **09 Marks**

a) Write four major causes and remedies for excessive oil consumption.
b) What will happen if radiator pressure cap is **not** fitted?
c) Write important four causes and remedies for noise in differential gear box?
d) State reasons and give remedies of air bubble entering in to the hydraulic brake fluid line.

**Q.2 Attempt any TWO of the following** **08 Marks**

a) State names of run-out checking methods for clutch plates? Describe any one with neat sketch.

b) Write any four causes and remedies for noise in Gear Box.

c) Write the procedure for dynamic wheel balancing.

**Q.3 Attempt any TWO of the following** **08 Marks**

a) Write the repainting procedure for car.

b) Describe the door adjustment procedure.

c) Write major four causes and remedies for vehicle pulling to one side.

**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 memorized 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 anyone 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**

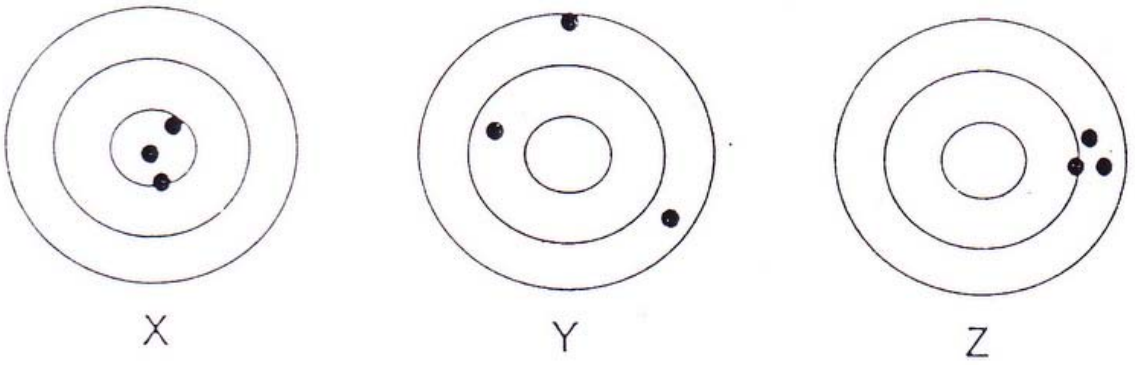
This relates to consistency with which examiners examine and mark the answer scripts/books. If marks assigned to answers are greatly influenced by the examiner's state of mind at that moment, no one will keep faith in the assigned marks, and reliability of marking is adversely affected.

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




| 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**.2.3 Sample Question Paper:

| **Exam Seat No.** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|

**Maharashtra State Board of Technical Education**

**Course Name: Automobile Engineering**

**Course Code : AE**

**Semester : Sixth**

**Subject : Vehicle System Maintenance**

**Marks : 100** **Times: 3 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.

---

**Q.1 (A) Attempt any Three of the following** **12 Marks**

a) Write function of following equipments

i) FIP Calibration machine. ii) Valve grinder

iii) Head Light aligner iv) Cylinder Honing machine.

b) State general safety precautions and procedures to be followed in auto workshop.

c) Prepare Scheduled maintenance for passenger car.

d) Describe the inspection procedure for cylinder bore.

**Q.1 (B) Attempt any One** **06 Marks**

a) Draw a layout required for a garage servicing different makes of 20 passenger cars per day. List important generalized and specialized equipments required for the same.

b) Describe the scheduled maintenance procedure for heavy vehicle after 30,000 KM run.

**Q.2 Attempt any Four** **16 Marks**

a) List the documents which are to be maintained in automobile workshop and show the format of

**Job card**.

b) State the criterion to decide whether a vehicle component is to be repaired or replaced.

c) State various tests conducted for mechanical fuel injector. Describe any one test with neat sketch.

d) What will happen if $O_2$ Sensor in MPFI System does not work?

e) What are major four probable causes and remedies for Low oil pressure in engine?

f) Write any four probable causes and remedies for 'soot in exhaust'

**Q.3 Attempt any Four of the following** **16 Marks**

a) Write stepwise procedure to carry out the vacuum test for cylinder with suitable sketch.

b) Write stepwise inspection procedure for radiator leakage.

c) What is vapor lock in petrol engine? How vapor lock can be removed?

d) If a milk tanker is not climbing hilly section. Write probable any four important causes and remedies.

e) Engine does not start in winter condition, state probable at least four reasons and give its remedies

**Q.4 (A) Attempt any three of the following** **12 Marks**

a) Write inspection procedure for lubrication system.

b) What is engine tune up? Write the procedure for engine tune up with help of block diagram.

c) How cylinder head inspection is carried out?

d) Write major four reasons and give remedies for clutch slippage.

**Q.4 (B) Attempt any One of the following** **06 Marks**

a) What is calibration of FIP? How calibration is carried out on FIP test bench?

b) Write procedure for wheel alignment with neat sketch.

**Q.5 Attempt any Four of the following** **16 Marks**

a) Write major four causes and remedies of humming noise from differential.

b) What is the necessity of bearing preload? Write its procedure?

c) Write stepwise procedure for checking differential ring gear run out.

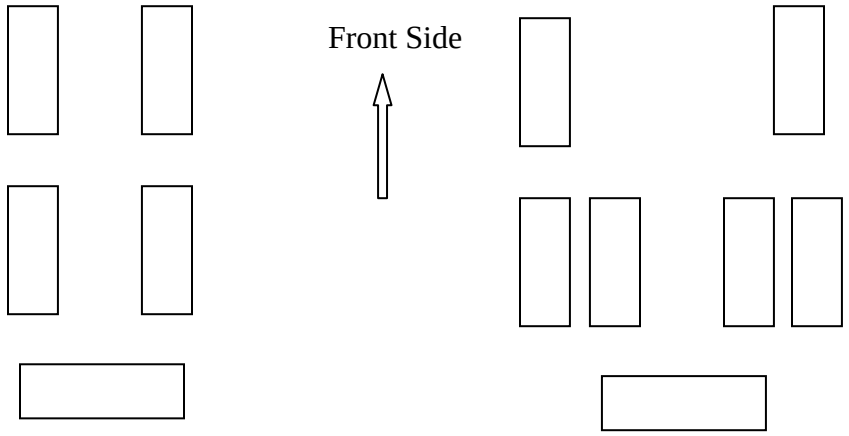
d) Write any four causes and remedies for noise in propeller shaft.

e) Write step wise procedure for clutch pedal adjustment with neat sketch.

f) What are the types of brake bleeding? Write procedure for manual bleeding with neat sketch.

**Q.6 Attempt any Four of the following** **16 Marks**

a) Suggest the tyre rotation in wheel arrangements shown in fig. and draw the same.




Four Wheeler with spare wheel

Six Wheeler with spare wheel

b) How will you enhance tyre life?

c) Write any four painting defects with neat sketch.

d) Describe frame alignment procedure with neat sketch.

e) Describe stepwise procedure for dent removal.