

CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR

(Advanced Automobile Engines - 17523)

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.

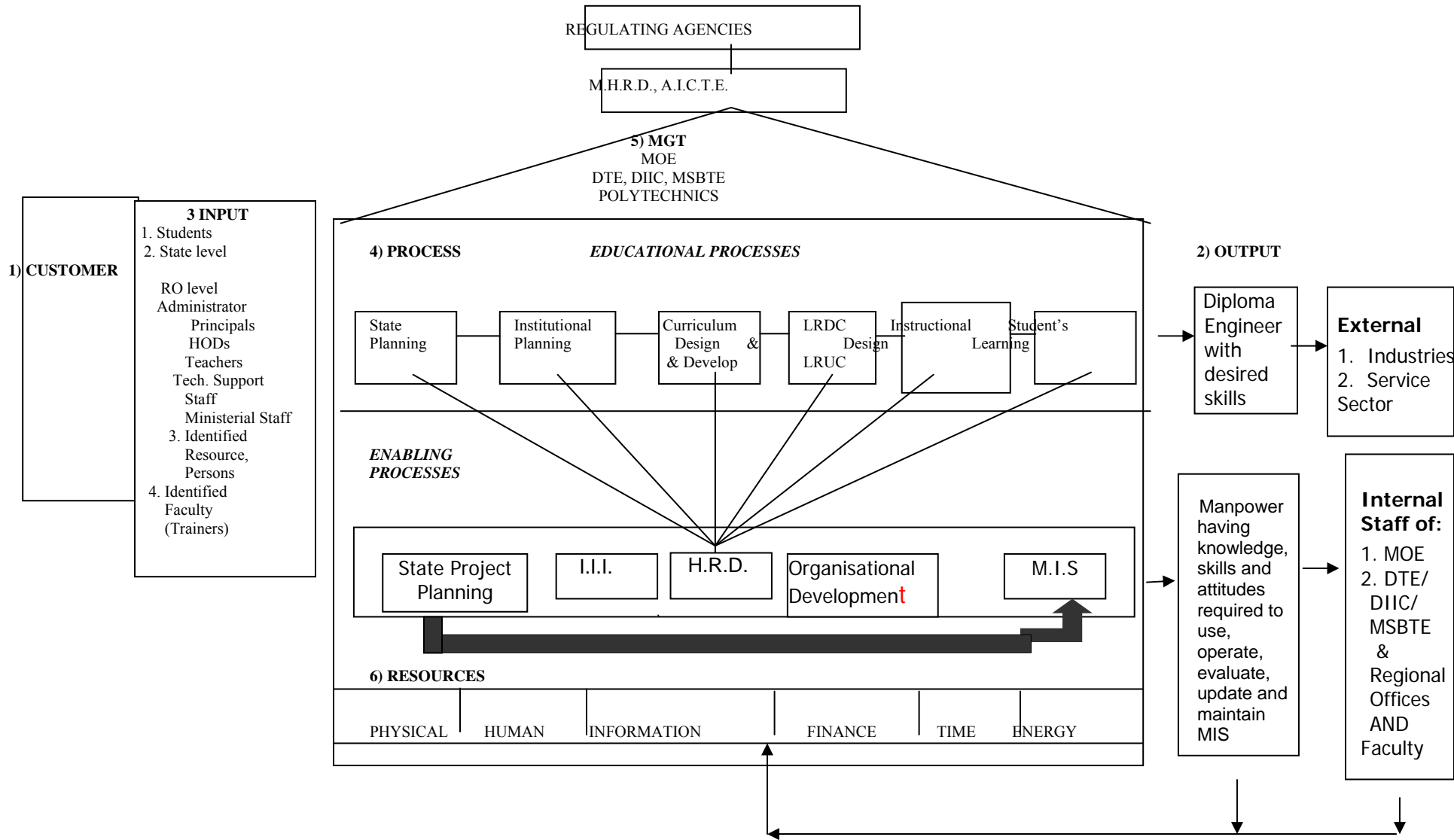


Fig 1 Systems Approach

1.4 Curriculum goals

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

1.5 DESIRED SKILLS

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

Life Skills:

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

Technological Skills:

Diploma engineers should possess following intellectual and motor skills in order to satisfactorily perform duties assigned to them:

A) Intellectual skills.

1. Read and interpret 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 Civil Engineering Group CAD and Building Materials have been added as an independent subject. Topics on Airport Engineering and Docks and Harbours have been added in the subject Transportation Engineering.

2. OBJECTIVES

2.1 Introduction

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

2.2 Domains of Learning:

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

There are following domains of learning:

A: Cognitive Domain relates to intellectual skills or abilities

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

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

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

2.3 LEVELS OF LEARNING:

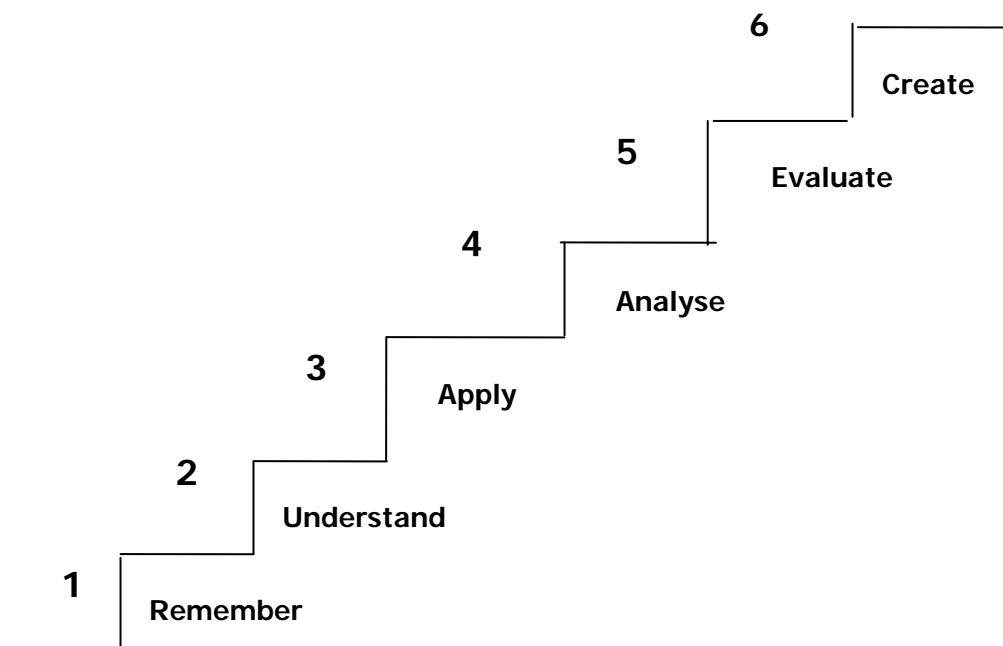
Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for

the purpose of writing objectives and assessment. Dr. Bloom's revised taxonomy is based on cognitive psychology and is two dimensional. First dimension is cognitive process dimension and other is knowledge dimension. Details of these two dimensions are given below.

2.4.1 Cognitive Domain:

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

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



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

Description of the Major Levels in the cognitive Domain (Bloom's Taxonomy)	Illustrative General Instructional Objectives	Illustrative verbs for stating specific learning outcomes
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.	Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/	Breakdown, diagram, differentiate, discriminate, distinguish, identify illustrate, infer, outline,

Learning outcomes here represent a higher intellectual level than “understand” and apply because they require an understanding of both the content and the structural form of the material.	adequacy of data.	point out, relate, select, separate, subdivide.
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2.4.2 Categories of Knowledge Dimension

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

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

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

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

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

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

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

2.5 Components of Curriculum:

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

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

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

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

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

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

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

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

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

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

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

3. CONTENT ANALYSIS

3.1 Components of Content Analysis:

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

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

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

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

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

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

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

3.1.1 FACTS:

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

3.1.2 CONCEPTS:

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

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

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

3.1.3 Concept Attributes:

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

Example: Example: The Concept of Transistor

Attributes:

1. Transistor means **Trans-fer** of res-istor.
2. Transistor has three regions Collector, Base and Emitter.
3. Transistor is current amplification device.
4. Output current depends on Current amplification factor

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

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

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

3.1.4 PRINCIPLES:

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

For Example: (related concepts are underlined>)

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

3.1.5 APPLICATIONS:

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

For example:

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

3.1.6 PROCEDURES:

While analysing the content of a topic you might come across certain standard procedures which are prescribed to perform an operation or a given task. These procedures should be

clearly identified and taught accordingly not to be left to chance. We should not pre-suppose that the students understand them. We cannot afford to take these things for granted.

For Example:

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

3.1.7 SKILLS (PSYCHOMOTOR):

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

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

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

For Example:

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

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

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

3.2 TEACHING OF CONCEPTS;

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

Steps Suggested:

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

3.3 TEACHING OF PRINCIPLES:

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

Steps:

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

3.4 CONCLUSION:

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

4. CURRICULUM:

Course Name : Diploma in Automobile Engineering

Course Code : AE

Semester : Fifth

Subject Title : Advanced Automobile Engines

Subject Code : 17523

Teaching and Examination Scheme:

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

NOTE:

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

Rationale:

Day by day vehicle manufacturers are adapting advanced technology. They are taking care of pollution norms as a social responsibility and at the same time fuel economy, best driving responses, noise controls, and maintenance free technology in vehicles. The use of electrical, electronics and software engineering is used to achieve the above mentioned tasks. From manufacturing and service point of view it is necessary to study, practically observe and gain necessary intellectual and motor skills. The contents in this subject will help students to cope up requirements of manufacturer and society.

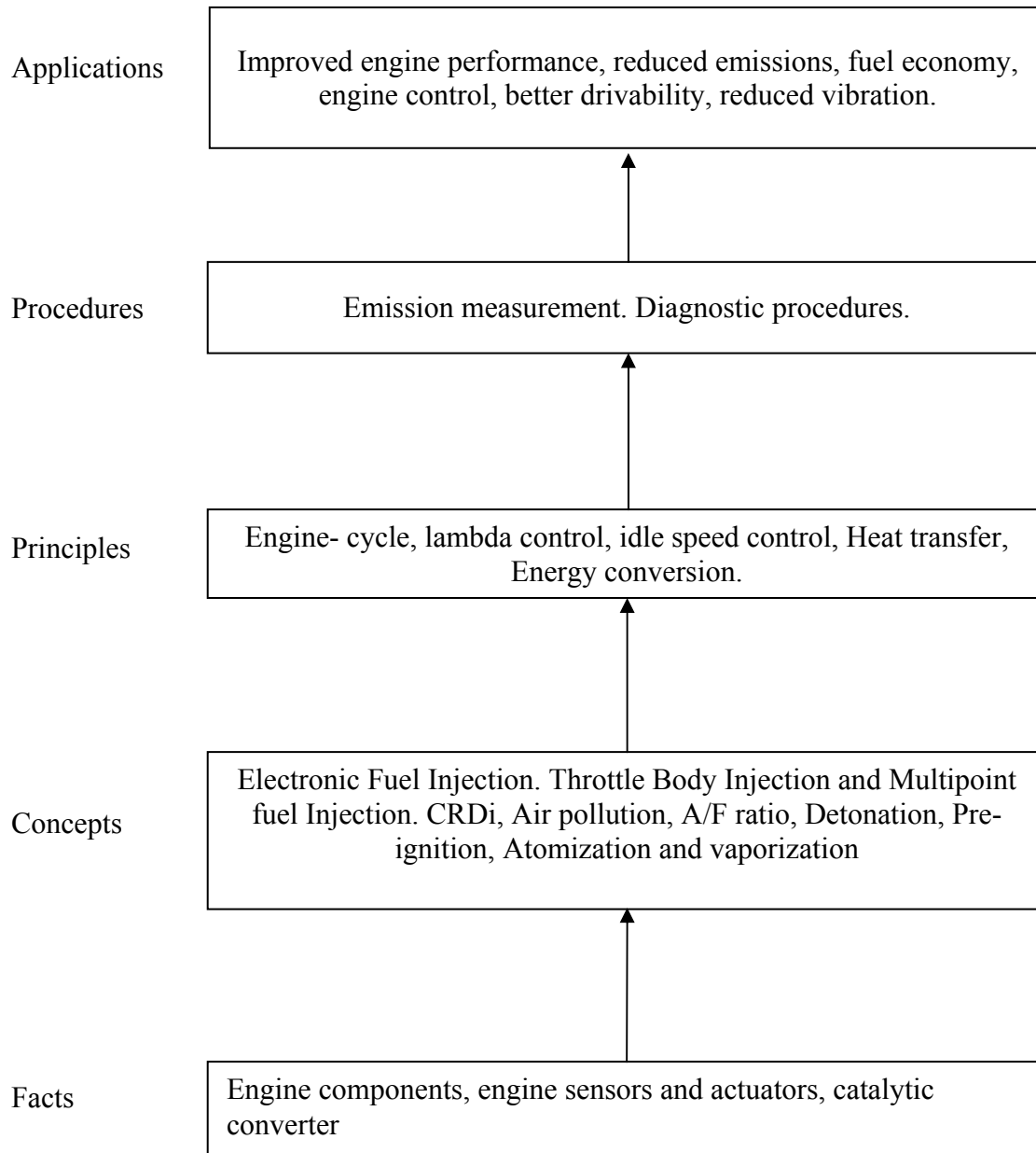
General Objectives:

The students will be able to

- Compare old technology and new technology used in engines.
- Understand combustion phenomena in SI and CI engines.

- Know new technologies like Electronic Fuel Injection, Common Rail Direct Injection, Turbo charging, and Emission control systems.
- Compare alternative fuels like Liquefied Petroleum Gas, Compressed Natural Gas.

Learning Structure:



Contents: Theory

Topic and Contents	Hours	Marks
<p>1: Theory of Combustion</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand combustion process and compare SI and CI engines. ➤ Know various types of combustion chambers. <p>Contents:</p> <p>1.1 Combustion in S.I. Engines 06 Marks</p> <ul style="list-style-type: none"> • Ignition limits • Stages of combustion in SI engine • Effect of engine variables on Ignition lag and flame propagation. <p>1.2 Abnormal combustion- 06 Marks</p> <ul style="list-style-type: none"> • Detonation, pre-ignition, • Surface ignition. • Effects of detonation, • Control of detonation. <p>1.3 SI engine combustion Chambers 04 Marks</p> <p>1.4 Combustion in CI engine 08 Marks</p> <ul style="list-style-type: none"> • Air Fuel ratio in Diesel engines • Delay period and variables affecting delay period. • Diesel knock and its control. • CI engine combustion chambers. • Comparison of SI and CI engines on the basis of thermodynamic and operating variables, performance characteristics. 	11	24
<p>2. Computer Controlled Petrol Engines.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Compare carbureted and advance engines. ➤ Know the functions and location of sensors, ECM and actuators in advance engines. ➤ Understand control functions of EFI system. <p>Contents:</p> <p>2.1 Introduction - 04 Marks</p> <ul style="list-style-type: none"> • Drawbacks of carbureted (SI) engines: Fuel distribution, Emission, Drivability, Power out- put, Fuel consumption, Air fuel ratio. <p>2.2 Throttle body injection (TBI) and Port fuel injection (PFI) systems 10 Marks</p> <ul style="list-style-type: none"> • Construction and working of TBI and PFI systems • Methods of fuel Injection: Sequential, Continuous, grouped, simultaneous injection. • Comparison of carbureted engine fuel supply system with TBI and MPFI System. <p>2.3 Sensors and Actuators of MPFI engine 10 Marks</p> <ul style="list-style-type: none"> • List, Function and Location of sensors and actuators of MPFI engine • Construction and working of pressure regulators, fuel injector, and fuel 	11	24

<p>pump.</p> <ul style="list-style-type: none"> • Electronic Control Module: Input and output control functions as fuel injection, idle speed control, EGR, canister purge. 		
<p>3. Computer controlled Diesel Engines.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know components and working of CRDI system. ➤ Understand benefits of CRDI system. <p>Contents:</p> <p>3.1 Electronically controlled Fuel injection system</p> <ul style="list-style-type: none"> • Block diagram of electronic control system • Electronically controlled diesel injection pump. <p>3.2 Common rail direct injection system(CRDI):</p> <ul style="list-style-type: none"> • Block diagram of CRDI system. • Features of CRDI system. • Major Components-Fuel injector, Block diagram of Electronic diesel control unit (EDC). High pressure fuel pump, High pressure accumulator. • CRDI System operation and advantages. • Diesel Engine Glow plugs: Construction and working. • Circuit diagram and operation of glow plug 	08	16
<p>4. Fuels and Alternative Energy Options for Auto Engines</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand properties of fuels. ➤ Know alternative fuel systems <p>Contents:</p> <p>4.1 Properties of various fuels used in IC engines-</p> <ul style="list-style-type: none"> • Gasoline, Diesel, LPG, CNG, Hydrogen, Alcohol, Bio diesel. • Fuels used in modern vehicles. <p>4.2 Alternative Fuels for SI and CI engines-</p> <ul style="list-style-type: none"> • LPG, CNG, Alcohol, Bio- diesel (Advantages and Limitations with respect to performance and emission) • LPG and CNG conversion kit block diagram <p>4.3 Electric cars and hybrid vehicles – need, advantages, limitations and working with block diagram</p>	06	12
<p>5. Advanced Features in Automobile engines</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know advanced features of automobile engines. <p>Contents:</p> <p>Concepts and Advantages of following features</p> <ul style="list-style-type: none"> • Variable Geometric Turbocharger (VGT) • Variable Valve Timing mechanism (VVT) • Digital Twin Spark Ignition (DTSI) • Gasoline Direct Ignition (GDI) • Variable Valve Timing and Electronic Lift Control (VTEC) 	04	08

<p>6. Fuel Economy, Air pollution and Emission Control</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know the different sources of pollutants in I.C. engine. ➤ Understand working of different pollution controlling devices. ➤ Know various emission norms. <p>Contents:</p> <p>6.1 Fuel economy and Air pollution 08 Marks</p> <ul style="list-style-type: none"> • Methods of improving fuel economy. • Pollutants from gasoline engines. • Gasoline engine emission control - engine design modification, treatment of exhaust gas, fuel modification. • Diesel emission, Diesel smoke and control <p>6.2 Emission control 08 Marks</p> <ul style="list-style-type: none"> • Exhaust-Gas recirculation (EGR) – EGR valve and control system • Positive crankcase ventilation (PCV) system • Evaporation emission control system • Euro Norms and Bharat stage Norms for cars. 	08	16
Total	48	100

Practicals:

Skills to be developed:

Intellectual Skills:

1. Identify types of combustion chamber.
2. Identify components of electronic fuel injection system (EFI) and CRDi system
3. Diagnose EFI system.
4. Diagnose engine condition from exhaust gas analysis and interpret results.

Motor Skills:

1. Observe combustion chamber.
2. Observe EFI and CRDi system components and their locations.
3. Use diagnostic tester for Electronics fuel injection system diagnosis.
4. Adopt recommended service manual procedure for testing EFI system and exhaust Gas analyzer application.

List of Practical's:

1. Identify Combustion chamber of multi cylinder S.I. and C. I. Engine and single cylinder 2/4 stroke engine
2. Identify, observe various sensors, actuators and ECM of MPFI engine. Draw a layout and write a report.
3. Dismantle & observe various components of electrical fuel feed pump of MPFI System.

4. Perform engine diagnosis of electronic fuel injection system using scan tool.
5. Identify and observe the components of Common Rail Direct Injection (CRDi) System.
6. Observe and draw layout of LPG or CNG Fuel supply system.
7. Perform exhaust gas analysis of an engine exhaust using 4-gas analyzer. Diagnose engine condition from exhaust gas analysis.
8. Identify & observe the EGR & PCV system used in an engine and draw layout.

Notes:

1. Practicals to be conducted in a group of 4 students.
2. Number of practicals shall be conducted simultaneously.
3. Visit to authorized service station is recommended for conducting practical number 4 and 5

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher / Edition
01	M.L Mathur R.P.Sharma	A Course in Internal Combustion engine	Dhanpat Rai Publication
02	V. Ganeshan	Internal Combustion engines	Tata McGraw – Hill
03	Haywood	Internal Combustion engines	Tata McGraw – Hill
04	Don Knowles	Automotive Principles Vol-I	Prentice Hall
05	H.N. Gupta	Fundamentals of I.C. Engines	PHI Learning Pvt. Ltd 2011
06	K.K. Ramalingam	Internal Combustion Engines	SCITECH 2 nd edition 2011

2. Websites:

- www.howstuffworks.com,
- www.autoshop101.com
- www.npkauto.com

5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic I	<p>Name: Theory of Combustion 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.</p>		
	Knowledge Category	Example/s of category	Teaching methodology
	FACT	Combustion chamber, spark plug/fuel injector	Demonstrate with use of PPT/Chart showing cylinder head and combustion chamber
	CONCEPT	Air-fuel ratio, combustion phenomenon, abnormal combustion	Explain the concept of combustion in classroom with chalk & board. Use PPT/Animations to show how combustion takes place inside the engine.
	PRINCIPLE	Law of conservation of energy.	Explain the law in classroom with chalk & board.
	PROCEDURE	Different stages of combustion, detonation/knocking phenomenon.	Draw P- θ diagram showing different stages of combustion in S.I. & C.I. engine. Explain the phenomenon of detonation and knocking with the help of suitable diagram in classroom.
APPLICATION	I.C. Engines	Explain the application of different types of combustion chambers used in I.C. engines.	
<p>Learning Resources: Books, Charts, PPT's and models</p> <p>Books: Title: 1) Internal Combustion Engines by M.L.Mathur & R.P.Sharma 2) Internal Combustion Engines by V. Ganeshan</p> <p>Teaching Aids: Cut section models of cylinder head and block of I.C Engine,</p> <p>PPTs: Combustion chambers for S.I. & C.I Engines, Detonation and knocking in I.C. Engines, P-θ diagram for S.I. & C.I Engines.</p>			

	Websites: www.slideshare.net www.howstuffworks.com www.npkauto.com																		
Lecture No.	Topic/ Subtopic to be covered																		
1	Combustion in S.I. Engines - Ignition limits																		
2	Combustion in S.I. Engines - Stages of combustion in SI engine																		
3	Combustion in S.I. Engines - Effect of engine variables on Ignition lag and flame propagation.																		
4	Abnormal combustion- Detonation, pre-ignition, Surface ignition.																		
5	Effects of detonation, Control of detonation.																		
6	SI engine combustion Chambers																		
7	Combustion in CI engine - Air Fuel ratio in Diesel engines																		
8	Delay period and variables affecting delay period.																		
9	Diesel knock and its control.																		
10	CI engine combustion chambers.																		
11	Comparison of SI and CI engines on the basis of thermodynamic and operating variables, performance characteristics.																		
Topic 2	<p>Name: Computer Controlled Petrol Engines.</p> <p>Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.</p> <p>e.g.</p> <table border="1"> <thead> <tr> <th>Knowledge Category</th> <th>Example/s of category</th> <th>Teaching methodology</th> </tr> </thead> <tbody> <tr> <td>FACT</td> <td>Carbureted engine, MPFI engine with Sensors, Actuators and ECM</td> <td>Explain the difference between carbureted engine and MPFI engine in class room.</td> </tr> <tr> <td>CONCEPT</td> <td>Electronic fuel injection, Throttle body injection and Multi-point fuel injection.</td> <td>Use PPT's, Video animations of electronic fuel injection system. Sensors, actuators can be physically shown in the class room/laboratory.</td> </tr> <tr> <td>PRINCIPLE</td> <td>Lambda control</td> <td>Explain with chalk and board/PPT's.</td> </tr> <tr> <td>PROCEDURE</td> <td>Working of TBI and PFI systems.</td> <td>Explain with chalk and board/PPT's.</td> </tr> <tr> <td>APPLICATION</td> <td>MPFI system used in modern petrol vehicles.</td> <td>Discuss the different applications of MPFI and TBI systems in class room.</td> </tr> </tbody> </table> <p>Learning Resources: Books, Charts, PPT's and models</p>	Knowledge Category	Example/s of category	Teaching methodology	FACT	Carbureted engine, MPFI engine with Sensors, Actuators and ECM	Explain the difference between carbureted engine and MPFI engine in class room.	CONCEPT	Electronic fuel injection, Throttle body injection and Multi-point fuel injection.	Use PPT's, Video animations of electronic fuel injection system. Sensors, actuators can be physically shown in the class room/laboratory.	PRINCIPLE	Lambda control	Explain with chalk and board/PPT's.	PROCEDURE	Working of TBI and PFI systems.	Explain with chalk and board/PPT's.	APPLICATION	MPFI system used in modern petrol vehicles.	Discuss the different applications of MPFI and TBI systems in class room.
Knowledge Category	Example/s of category	Teaching methodology																	
FACT	Carbureted engine, MPFI engine with Sensors, Actuators and ECM	Explain the difference between carbureted engine and MPFI engine in class room.																	
CONCEPT	Electronic fuel injection, Throttle body injection and Multi-point fuel injection.	Use PPT's, Video animations of electronic fuel injection system. Sensors, actuators can be physically shown in the class room/laboratory.																	
PRINCIPLE	Lambda control	Explain with chalk and board/PPT's.																	
PROCEDURE	Working of TBI and PFI systems.	Explain with chalk and board/PPT's.																	
APPLICATION	MPFI system used in modern petrol vehicles.	Discuss the different applications of MPFI and TBI systems in class room.																	

	<p>Books: Title: 1) Internal Combustion Engines by M.L.Mathur & R.P.Sharma 2) Internal Combustion Engines by V. Ganeshan 3) Internal Combustion Engines by J.B. Heywood.</p> <p>Teaching Aids: Demonstration/working models of MPFI Engine, PPTs: Throttle body injection and Multi-point fuel injection systems .</p> <p>Websites: www.slideshare.net www.howstuffworks.com www.npkauto.com</p>															
Lecture No.	Topic/ Subtopic to be covered															
1	Introduction - Drawbacks of carbureted (SI) engines: Fuel distribution, Emission, Drivability, Power out- put, Fuel consumption, Air fuel ratio.															
2	Construction and working of TBI system.															
3	Construction and working of PFI system.															
4	Methods of fuel Injection: Sequential, Continuous, grouped, simultaneous injection.															
5	Comparison of carbureted engine fuel supply system with TBI and MPFI System.															
6	List, Function and Location of sensors of MPFI engine															
7	List, Function and Location of actuators of MPFI engine															
8	Construction and working of pressure regulators and fuel pump.															
9	Construction and working of fuel injector.															
10	Electronic Control Module: Input and output control functions as fuel injection, idle speed control.															
11	Electronic Control Module: Input and output control functions as EGR, canister purge.															
Topic 3	<p>Name: Computer Controlled Diesel Engines. Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful. e.g.</p> <table border="1"> <thead> <tr> <th>Knowledge Category</th> <th>Example/s of category</th> <th>Teaching methodology</th> </tr> </thead> <tbody> <tr> <td>FACT</td> <td>Common rail direct injection engine with Sensors, Actuators and ECM</td> <td>Explain the difference between conventional diesel engine and CRDi engine in class room.</td> </tr> <tr> <td>CONCEPT</td> <td>Electronic fuel injection, Common rail system.</td> <td>Use PPT's, Video animations of electronic fuel injection system. Sensors, actuators can be physically shown in the class room/ laboratory.</td> </tr> <tr> <td>PRINCIPLE</td> <td>Lean burn technology and multiple injection</td> <td>Explain with chalk and board/PPT's.</td> </tr> <tr> <td>PROCEDURE</td> <td>Working of CRDi system.</td> <td>Explain with chalk and board/PPT's. Draw block</td> </tr> </tbody> </table>	Knowledge Category	Example/s of category	Teaching methodology	FACT	Common rail direct injection engine with Sensors, Actuators and ECM	Explain the difference between conventional diesel engine and CRDi engine in class room.	CONCEPT	Electronic fuel injection, Common rail system.	Use PPT's, Video animations of electronic fuel injection system. Sensors, actuators can be physically shown in the class room/ laboratory.	PRINCIPLE	Lean burn technology and multiple injection	Explain with chalk and board/PPT's.	PROCEDURE	Working of CRDi system.	Explain with chalk and board/PPT's. Draw block
Knowledge Category	Example/s of category	Teaching methodology														
FACT	Common rail direct injection engine with Sensors, Actuators and ECM	Explain the difference between conventional diesel engine and CRDi engine in class room.														
CONCEPT	Electronic fuel injection, Common rail system.	Use PPT's, Video animations of electronic fuel injection system. Sensors, actuators can be physically shown in the class room/ laboratory.														
PRINCIPLE	Lean burn technology and multiple injection	Explain with chalk and board/PPT's.														
PROCEDURE	Working of CRDi system.	Explain with chalk and board/PPT's. Draw block														

			diagram of Electronic Control System.												
	APPLICATION	CRDi system used in modern diesel vehicles.	Discuss the applications of CRDi systems in class room.												
	<p>Learning Resources: Books, Charts, PPT's and models</p> <p>Books:</p> <p>Title: 1) Internal Combustion Engines by M.L.Mathur & R.P.Sharma 2) Internal Combustion Engines by V. Ganeshan 3) Internal Combustion Engines by J.B. Heywood. 4) Automotive Principles – Vol. I by Don Knowles</p> <p>Teaching Aids:</p> <p>Demonstration/working models of CRDi Engine, PPTs: Common Rail System, CRDi systems .</p> <p>Websites: www.slideshare.net www.howstuffworks.com www.npkauto.com</p>														
Lecture No.	Topic/ Subtopic to be covered														
1	Block diagram of electronic control system														
2	Electronically controlled diesel injection pump.														
3	Block diagram of CRDI system. Features of CRDI system.														
4	Major Components-Fuel injector, Block diagram of Electronic diesel control unit (EDC).														
5	Major Components- High pressure fuel pump, High pressure accumulator.														
6	CRDI System operation and advantages.														
7	Diesel Engine Glow plugs: Construction and working.														
8	Circuit diagram and operation of glow plug														
Topic 4	<p>Name: Fuels and Alternative Energy Options for Auto Engines</p> <p>Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.</p> <p>e.g.</p> <table border="1"> <thead> <tr> <th>Knowledge Category</th> <th>Example/s of category</th> <th>Teaching methodology</th> </tr> </thead> <tbody> <tr> <td>FACT</td> <td>Alternative fuels – LPG, CNG, Alcohol, Biodiesel, Hydrogen.</td> <td>List and discuss different alternative fuels for Petrol and diesel engines.</td> </tr> <tr> <td>CONCEPT</td> <td>Conservation of petroleum fuels by use of alternate energy sources.</td> <td>Use PPT's of alternative fuels used in I.C. engines. Discuss properties of different alternative fuels in class room.</td> </tr> <tr> <td>PRINCIPLE</td> <td>Properties of automotive fuels</td> <td>Discuss the essential properties of different alternative fuels.</td> </tr> </tbody> </table>			Knowledge Category	Example/s of category	Teaching methodology	FACT	Alternative fuels – LPG, CNG, Alcohol, Biodiesel, Hydrogen.	List and discuss different alternative fuels for Petrol and diesel engines.	CONCEPT	Conservation of petroleum fuels by use of alternate energy sources.	Use PPT's of alternative fuels used in I.C. engines. Discuss properties of different alternative fuels in class room.	PRINCIPLE	Properties of automotive fuels	Discuss the essential properties of different alternative fuels.
Knowledge Category	Example/s of category	Teaching methodology													
FACT	Alternative fuels – LPG, CNG, Alcohol, Biodiesel, Hydrogen.	List and discuss different alternative fuels for Petrol and diesel engines.													
CONCEPT	Conservation of petroleum fuels by use of alternate energy sources.	Use PPT's of alternative fuels used in I.C. engines. Discuss properties of different alternative fuels in class room.													
PRINCIPLE	Properties of automotive fuels	Discuss the essential properties of different alternative fuels.													

	PROCEDURE	Block diagram of Electric car and Hybrid vehicle. Conversion of petrol vehicle into LPG and diesel vehicle into CNG vehicle.	Explain with chalk and board/PPT's. Identify the system and list the components during laboratory session.
	APPLICATION	Alternative fuels used in modern vehicles.	Discuss the use of different alternative fuels with advantages, disadvantages and limitations in class room.
	<p>Learning Resources: Books, Charts, PPT's and models</p> <p>Books: Title: 1) Internal Combustion Engines by M.L.Mathur & R.P.Sharma 2) Internal Combustion Engines by V. Ganeshan 3) Internal Combustion Engines by J.B. Heywood.</p> <p>Teaching Aids: Board models of LPG/CNG Kit. PPTs: Fuel properties, comparison of fuels.</p> <p>Websites: www.slideshare.net www.howstuffworks.com</p>		
Lecture No.	Topic/ Subtopic to be covered		
1	Properties of various fuels used in IC engines- Gasoline, Diesel, LPG, CNG.		
2	Properties of various fuels used in IC engines- Hydrogen, Alcohol, Bio diesel. • Fuels used in modern vehicles.		
3	Alternative Fuels for SI and CI engines-LPG, CNG, (Advantages and Limitations with respect to performance and emission)		
4	Alternative Fuels for SI and CI engines- Alcohol, Bio- diesel (Advantages and Limitations with respect to performance and emission)		
5	LPG and CNG conversion kit block diagram.		
6	Electric cars and hybrid vehicles – need, advantages, limitations and working with block diagram		
Topic 5	Name: Advanced Features in Automobile engines. 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.		

Knowledge Category	Example/s of category	Teaching methodology
FACT	Turbocharger, Valve Timing, Spark Plug,	Use chalk and board method to explain the facts in the class room.
CONCEPT	VGT, VVT, DTSi, GDI, VTEC	Use PPT's, Video animations to explain the concepts in the class room.
PRINCIPLE	Fluid principle, Spark ignition, multiple injection	Explain with chalk and board and PPT's.
PROCEDURE	Variable geometric turbo-charging, Variable Valve timing, Twin spark ignition.	Use PPT's, Video animations to explain the procedures in the class room.
APPLICATION	Advanced technologies used in Automobile Engines	Discuss the different applications with their advantages and disadvantages in class room.

Learning Resources: Books, Charts, PPT's and models

Books:

- Title: 1) The Motor Automotive Technology by Anthony Schaller
 2) Internal Combustion Engines by V. Ganeshan
 3) Internal Combustion Engines by J.B. Heywood.
 4) Automotive Principles Vol. I by Don Knowles

Teaching Aids:

Demonstration/working models of MPFI Engine, DTSi engine, CRDi engine
 PPTs: VGT, VVT, DTSi, GDI, VTEC systems.

Websites: www.slideshare.net
www.howstuffworks.com

Lecture No.	Topic/ Subtopic to be covered
1	Concepts and Advantages of - Variable Geometric Turbocharger (VGT)
2	Concepts and Advantages of - Digital Twin Spark Ignition (DTSI)
3	Concepts and Advantages of - Gasoline Direct Ignition (GDI)
4	Concepts and Advantages of - Variable Valve Timing mechanism (VVT) Variable Valve Timing and Electronic Lift Control (VTEC)
Topic 6	Name: Fuel Economy, Air pollution and Emission Control. 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	Engine emissions, Catalytic Converter,	Explain the facts with their purpose in class room.
CONCEPT	Air pollution, Fuel economy, EGR, PCV	Use PPT's, Video animations to show effects of air pollution and concepts of EGR, PCV systems, EGR valve, PCV valve, Charcoal canister can be physically shown in the class room/laboratory.
PRINCIPLE	Principle of Energy Conservation	Explain with chalk and board.
PROCEDURE	EGR, PCV, Evaporative emission control system	Explain with chalk and board/PPT's in class room.
APPLICATION	Emission control systems used in modern automobiles.	Discuss the different applications of emission control systems in class room. Identify the systems and components during practical sessions.

Learning Resources: Books, Charts, PPT's and models

Books:

- Title: 1) Internal Combustion Engines by M.L.Mathur & R.P.Sharma
 2) Internal Combustion Engines by V. Ganeshan
 3) Internal Combustion Engines by J.B. Heywood.

Teaching Aids:

Demonstration/Board models of emission control systems.

PPTs: EGR, PCV, Evaporative emission control system, Euro/Bharat Stage Norms.

Websites: www.slideshare.net

www.howstuffworks.com

Lecture No.	Topic/ Subtopic to be covered
1	Fuel economy and Air pollution -Methods of improving fuel economy. Pollutants from gasoline engines.
2	Gasoline engine emission control - engine design modification,
3	Gasoline engine emission control - treatment of exhaust gas, fuel modification.
4	Diesel emission, Diesel smoke and control
5	Exhaust-Gas recirculation (EGR) – EGR valve and control system
6	Positive crankcase ventilation (PCV) system
7	Evaporation emission control system
8	Euro Norms and Bharat stage Norms for cars.

5.2 Planning and Conduct of Test:

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

5.3 Details about conduct of assignments:

5.4 Strategies for Conduct of Practical:

5.4.1 Suggestions for effective conduct of practical and assessment:

1. Use proper tools and equipments for removing, dismantling, assembling and refitting the desired components/ assemblies etc. Students should carefully and safely handle the tools and equipments.
2. Identify and observe location of various sensors, actuators and ECM of MPFI systems, CRDi system. Use working demonstration models as well as vehicles.
3. Actual fuel pump removed from vehicle should be dismantled and assemble.
4. Use standard scan tool for diagnosis of EFI system. Teacher shall explain the function and features of scan tool for diagnosis.
5. Identify and list components of LPG and CNG supply systems, EGR and PCV systems. Draw layouts and analyze the sequence of components.
6. Make proper connections of exhaust gas analyzer to check exhaust emissions.

Note

1. All the practical's may be performed in a group of 4 to 6 students.

5.4.2 Preparation for conduct of practical

Working models, cut section models, Board models, tools, equipments, components of required systems should be kept ready for practical. Teacher shall get proper assistance from laboratory technicians to effectively conduct the practical and shall remain with students throughout the practical session.

6. Mode of assessment:

1.1 Class Test:

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

6.1.2 Sample Test Papers:

Sample Test Paper I

Roll No.				
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17523

Institute Name:

Course Name: Automobile Engineering

Course Code: AE

Semester: Fifth

Subject: Advanced Automobile Engines

Marks: **25**

Time: **1 hour**

Instructions:

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

Q1. Attempt any **THREE**

09 marks

- a) **State** three engine variables affecting ignition lag.
- b) Describe the effect of air fuel- ratio on flame speed.
- c) Draw 'I' head combustion chamber used in S.I. engine and label it .
- d) State the function and location of MAP sensor.

Q2. Attempt any TWO

08 marks

- a) What is delay period? State two variables affecting delay period.
- b) Describe the working of fuel pump used in MPFI system.
- c) Give two advantages and two drawbacks of DI combustion chamber.

Q3. Attempt any ONE

08 marks

- a) Describe with neat sketch idle speed control as an output control function of ECM.
- b) State four methods of fuel injection. Describe any two.

Sample Test Paper II

Roll No.				
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17523

Institute Name:

Course Name: Automobile Engineering

Course Code: AE

Semester: Fifth

Subject: Advanced Automobile Engines

Marks: **25**

Time: **1 hour**

Instructions:

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

Q1. Attempt any THREE

09 marks

- a) **State** three features of CRDI system.
- b) List three major components of CRDI system and write one function of each.
- c) Draw a neat labeled block diagram of Electronic control system in CRDI system.
- d) Describe concept of VVT.

Q2. Attempt any TWO

08 marks

- a) Compare LPG and CNG as I.C. engine fuels on the basis of – i) Fuel tank size ii) Storage pressure iii) Cost iv) Safety.
- b) State EURO III norms for a car using petrol as a fuel.
- c) Describe the working of Evaporative Emission Control system.

Q3. Attempt any ONE

08 marks

- a) With a neat sketch describe working of EGR system. State two advantages of EGR system.
- b) Draw a neat labeled block diagram of CRDI system. Describe its working.

6.2 End of Semester Theory Paper

6.2.1 Characteristics of a Good Examination Question Paper

6.2.1.1 Introduction

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

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

- Validity
- Reliability
- Objectivity
- Usability

6.2.1.2 Validity

Validity refers to the extent to which it measures what it intends to measure. If we design a test or a question paper to measure what students have learnt in a subject, say “Applied Mechanics”, it should measure their achievement in Applied Mechanics only, nothing else; and the scores in this subject are not distorted by irrelevant factors. Basically, the, validity is always concerned with the specific use of the test results and the soundness of our proposed interpretations.

There are different types of validities of a test/question paper. In our examination question paper it is adequate and appropriate to consider only one type of validity i.e. content validity. The content validity is related to the extent to which the question paper conforms to the curriculum content and the pre-determined objectives. This validity is ensured by designing

question paper that matches with the specification table, which contains content matter to be tested and the cognitive levels at which this content is to be tested.

6.2.1.3 Reliability

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

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

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

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

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

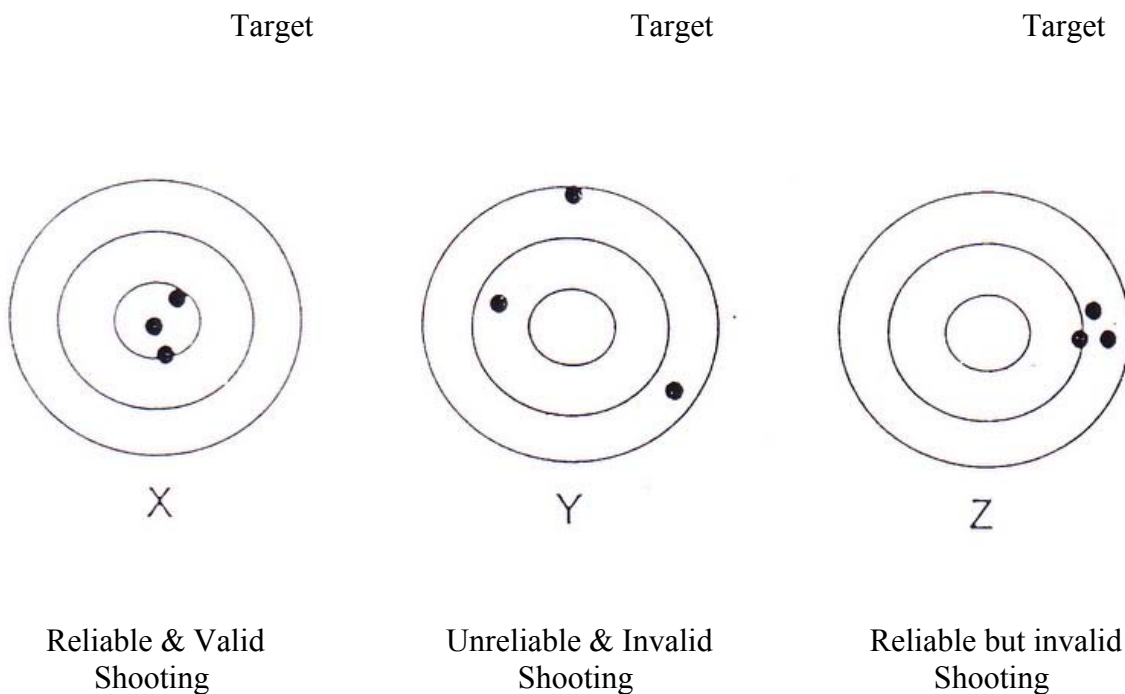
ii) **Examiners Objectivity**

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

iii) **Number of Questions**

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

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



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.									
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17523

Maharashtra State Board of Technical Education

Course Name: **Automobile Engineering**

Course Code: AE

Semester: Fifth

Title of the Subject: Advanced Automobile Engine

Subject Code: 17523

Marks: 100

Time: 3 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

Q1. (A) Attempt any THREE of the following

12 Marks

- a) What is meant by ignition limits? Give the ignition limits for S.I. engine.
- b) List four drawbacks of carbureted SI engine.
- c) State four advantages of using CRDI system.
- d) Write four properties of gasoline as a fuel for IC engine.

(B) Attempt any ONE of the following

06 Marks

- a) With the help of suitable sketch describe the working of fuel injector.
- b) Draw a neat P-V diagram showing the stages of combustion in SI engine. List the stages.

Q2. Attempt any FOUR of the following

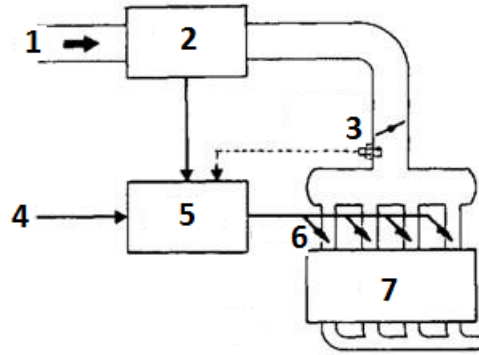
16 Marks

- a) Define Pre-ignition and surface ignition.
- b) Distinguish between TBI and PFI system (four points).
- c) Draw a labeled block diagram indicating EDC unit of a CRDI system.
- d) Compare SI and CI engine on the basis of – i) Thermodynamic cycle
ii) Compression ratio iii) Power Output per unit weight iv) Fuel consumption.
- e) List four types of combustion chambers used in CI engines.
- f) Draw a neat graph to indicate effect of compression ratio on delay period.

Q3. Attempt any FOUR of the following

16 Marks

- a) Identify and state the given block diagram. Also mention the names of components Indicated by the numbers.



- List three methods of fuel injection. Describe any one.
- Illustrate with example fuel injection as an output control function of ECM.
- What is Glow Plug? Why and where it is used?
- Draw a neat labeled circuit diagram of Glow Plug.
- Describe the working of high pressure accumulator.

Q4. (A) Attempt any THREE of the following

12 Marks

- List any two fuels used in modern cars. Compare them on the basis of –
i) Calorific value ii) Volatility iii) Octane rating
- Draw a labeled block diagram of parallel type hybrid vehicle.
- LPG is used as a fuel for petrol vehicle. Justify your answer.
- What does DTSi stands for? State two advantages of DTSi system.

(B) Attempt any ONE of the following

06 Marks

- With the help of neat sketch describe construction and working of High Pressure Pump used in CRDI system.
- Draw a labeled block diagram of LPG conversion Kit. Describe its working.

Q 5. Attempt any TWO of the following

16 Marks

- Prepare a chart showing the tendency of following characteristics to reduce detonation or Knock in SI and CI engine-
i) Ignition temperature of fuel ii) Ignition delay iii) Compression ratio
iv) Inlet temperature v) Inlet Pressure vi) Speed vii) Cylinder size
viii) Cylinder wall temperature.
- Identify and state the method used to control production of NO_x in combustion chamber of an engine. How the method is applied to do so? Illustrate with neat sketch.
- How catalytic converter performs under oxidation and reduction of exhaust gas? Give chemical reactions for the same. Why Oxygen sensors are fitted at inlet and outlet of catalytic converter.

Q 6. Attempt any FOUR of the following

16 Marks

- How VGT is beneficial over conventional turbocharger? (Give two points).
- State four methods to improve fuel economy of a vehicle.

- c) Describe any two sources of pollutants from gasoline engine.
d) What is diesel smoke? State two methods to control diesel smoke.
e) Describe the operation of PCV valve under two operating conditions of an engine.

Marking Scheme for Sample Question Paper_17523_AAE

Q. No	Sub Question	Bit	Distribution of Marks	Total Marks	Remarks
1	A	a	Meaning of ignition limits – 2 Marks Ignition limits for S.I. engine – 2 Marks	4	
		b	Four drawbacks of carbureted IC engine – 1 Mark each	4	
		c	Four advantages of CRDI engine – 1 Mark each	4	
		d	Four properties of gasoline– 1 Mark each	4	
	B	a	Neat labeled sketch of fuel injector – 4 Marks Working -2Marks	6	
		b	Neat P-θ diagram – 4 Marks, List of stages – 2Marks	6	
2		a	Definition of Pre-ignition - 2Marks, Definition of Surface ignition - 2Marks,	4	
		b	Distinguish - four points – 1 Mark each	4	
		c	Suitable block diagram of EDC unit – 3 Marks Correct Labeling – 1Mark	4	
		d	Comparison on the basis of four given parameters – 1 Mark each	4	
		e	Four types of CI engine Combustion chambers – 1mark each.	4	
		f	Appropriate graph – 4 Marks	4	
3		a	Identification of block diagram – 1 Mark Names of components indicated by number – 3 Marks	4	
		b	Methods of fuel injection (List) – 1 Mark Description of any one method – 3 Marks	4	
		c	Correct illustration – 4 marks	4	
		d	Glow Plug – 2 Marks	4	

			Reason – 1Mark, Location – 1 Mark		
		e	Circuit diagram of glow plug – 3 Marks Correct labeling – 1 Mark	4	
		f	Description of working – 4 Marks	4	
4	A	a	Two fuels used in modern cars – 1 Mark Comparison on the basis of given parameters – 1 Mark each.	4	
		b	Suitable block diagram – 3 Marks Correct labeling – 1 Mark	4	
		c	Appropriate justification – 4 Marks	4	
		d	DTSi (Full form) – 2 Marks, Two advantages – 2 Marks.	4	
	B	a	Neat Sketch of High pressure pump – 2 Marks Construction – 2 Marks, Working -2 Marks.	6	
		b	Suitable block diagram – 3 Marks, Correct labeling – 1 Mark, Working – 2 Marks	6	
5		a	Chart showing tendency of given characteristics to reduce knock/detonation – 1 mark each	8	
		b	Identification of method – 1 mark, Application of method – 3marks, Neat sketch – 2 marks, illustration -2 marks	8	
		c	Function of catalytic converter – 4 Marks Chemical reactions – 2 Marks , Reason for using O ₂ sensor – 2 marks	8	
6		a	Two points regarding benefits of VGT with proper justification – 4 Marks.	4	
		b	Four Methods to improve fuel economy – 1 Mark each	4	
		c	Two sources of Pollutants – 2 marks each	4	
		d	Diesel Smoke – 2 Marks Two methods to control diesel smoke - 1 Mark each.	4	
		e	Operation of PCV valve under two operating conditions – 2 Marks each	4	

