CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR

(Automotive Electrical And Electronic Systems 17617)

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.

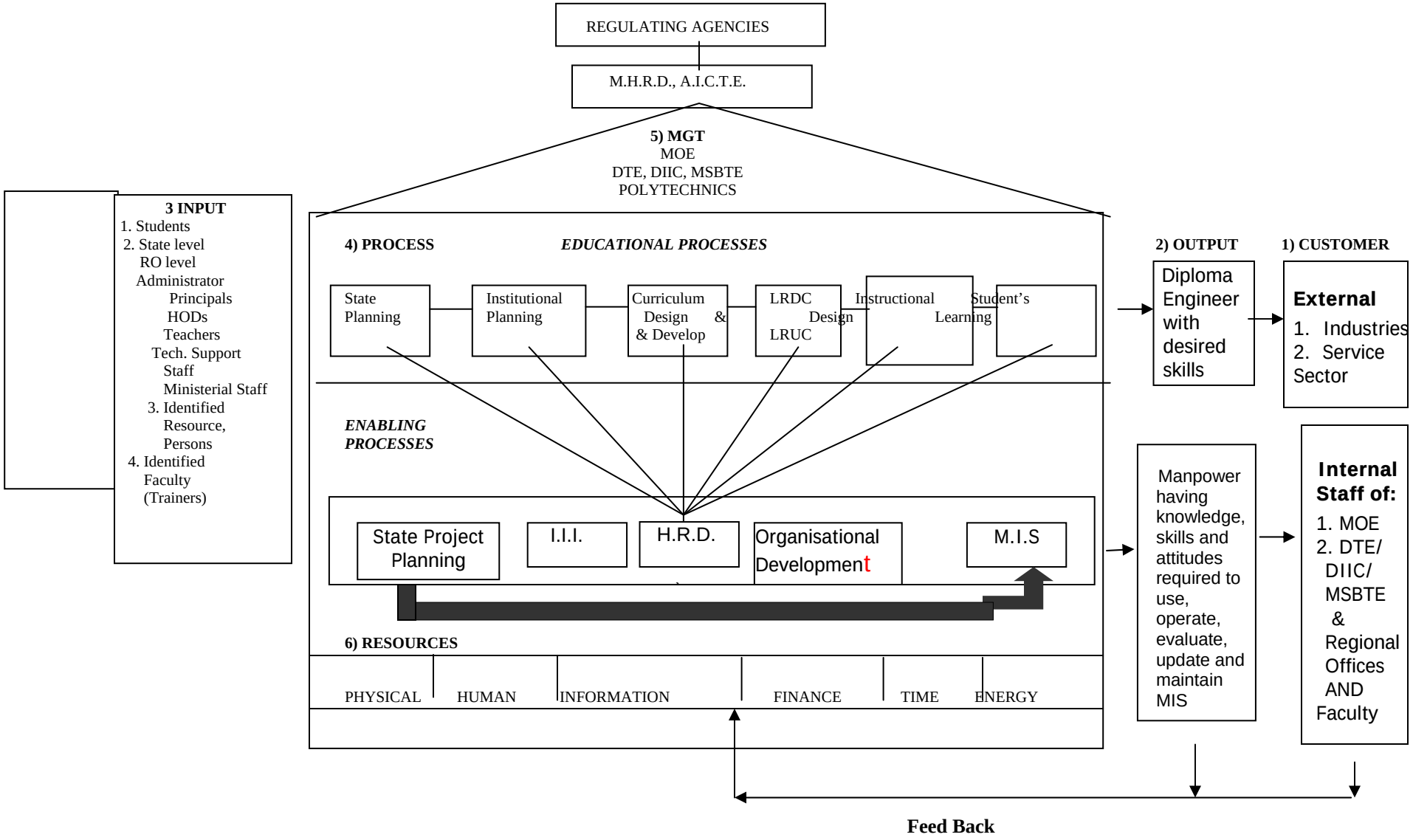


Fig 1 Systems Approach

1.4 Curriculum goals

1. To develop l. confidence in students by providing more exposure to industry experience and world of work at global 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) Understand the operations of Automotive Electrical and Electronic Components, and working of electrical accessories.
2) Apply various test procedures for battery as specified by manufacturers.
3) Adopt the precautions while handling a battery.
4) Identify the alternator components, starter motor components and understand test procedure of the components.
5) Understand the test and service procedure for spark plug, distributor and spark plug cords.
6) Identify and locate sensors and understand diagnostic procedures. (On board and stand alone diagnosis).
7) Understand purpose and operation of advanced automotive accessories.

B) Motor Skills.

1) Test electrical circuits for simple circuit defects.
2) Measure parameters such as current, voltage and voltage drop using multi-meter.
3) Use hydrometer, use temperature correction factor.
4) Perform starter motor tests as specified by manufacturer.
5) Perform alternator tests and components tests as specified by manufacturer.
6) Use of stroboscope operation for ignition timing adjustment.

1.6 Salient Changes in the curriculum:

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

examination of 25 Marks each will be conducted separately and the minimum passing marks for Applied Science will be the combination of both the sections. . It is mandatory to appear for theory and practical examination of both parts. Candidate remaining absent in any examination of any section will not be declared successful for that exam head.

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

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.

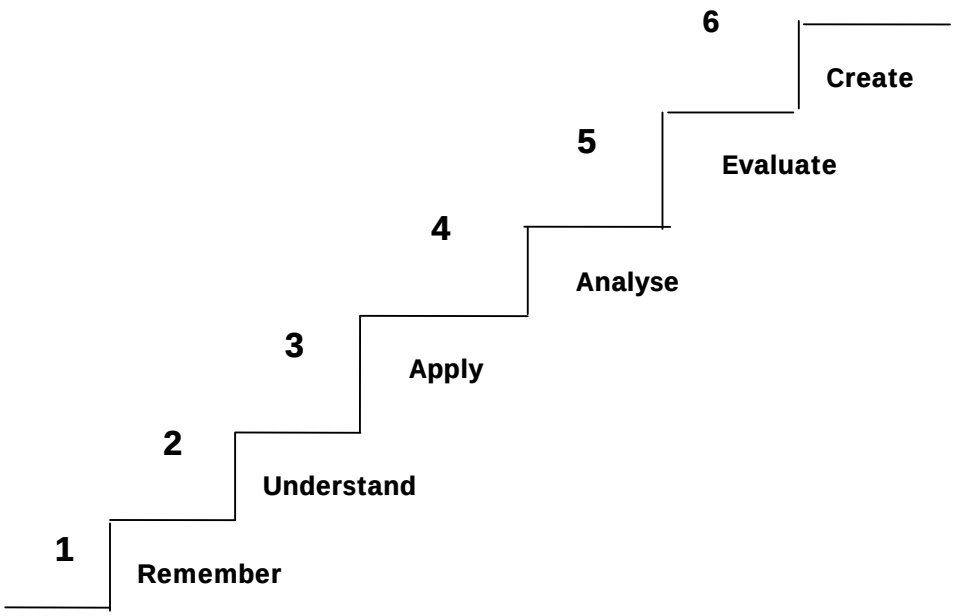
2.3 LEVELS OF LEARNING:

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

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

2.5.3 Learning Structure: It graphically/pictorially indicates the content of the curriculum of the subject and what is to be learnt in the subject. As you know that Cognitive Domain knowledge is divided in four components as mentioned in the Two dimensional grid. Of this Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the applications.
Facts, Concepts, Principles are used in developing procedures and applications. So these are given sequentially below procedure as Principles, Concepts and Facts in their order. Learning structure also provide an idea about how to develop the subject logically to achieve the objectives.

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

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

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

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

3. CONTENT ANALYSIS

3.1 Components of Content Analysis:

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

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

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

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

Since the nature of the components of content (1 to 7) differs from one another. These are learned by the students differently as different mental processes are involved in learning these components. The immediate implication of this varying nature of components is that these need to be taught differently and assessed differently. For example, if you look at components I to 5 all of which belong to Cognitive Domain of Learning; Component 6 belongs to Psychomotor Domain and Component 7 belongs to Affective Domain (cannot be taught as these attitudes are caught), you

will find that these differ from one another. The classification of human behaviors (activities) into the above three domains of learning entails the use of entirely different methods and media of instruction. Different locations of learning (classroom, laboratories, workshops, field visits) need to be selected.

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

3.1.1 FACTS:

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

3.1.2 CONCEPTS:

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

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

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

3.1.3 Concept Attributes:

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

Example: The Concept **of Friction**

Attributes:

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

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

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

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

3.1.4 PRINCIPLES:

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

For Example: (related concepts are underlined)

1. Actions and reactions are equal and opposite.
2. Ohm's law I = V/R is a principle, where I (Current), V (Voltage), and R (Resistance) are the concepts. While teaching a principle we must recall the concepts which it involves. These concepts might have been taught in the previous lesson. As you already know, concept learning is a prerequisite to Principle learning. Thus we recall the concepts of current,

voltage and resistance by asking questions to the students. Only after that we must tell the relationship among these i.e. Ohm's Law.

3.1.5 APPLICATIONS:

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

For example:

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

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

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

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

3.1.6 PROCEDURES:

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

For Example:

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

3.1.7 SKILLS (PSYCHOMOTOR):

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

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

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

For Example:

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

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

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

3.2 TEACHING OF CONCEPTS;

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

Steps Suggested:

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

3.3 TEACHING OF PRINCIPLES:

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

Steps:

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

3.4 CONCLUSION:

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

4. CURRICULUM:

Course Name : Diploma in Automobile Engineering

Course Code : AE

Semester : Sixth

Subject Title : Automotive Electrical and Electronics Systems

Subject Code : 17617

Teaching and Examination Scheme:

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

NOTE:

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

Rationale:

Basic Electrical and Electronics subject learnt in the previous semester forms a pre-requisite of this subject. Today majority of development in automobiles is taking place in field of automobile electrical and electronic systems. Microprocessors and Embedded systems are widely incorporated in modern vehicles. The knowledge of this subject is helpful in understanding functioning, application and maintenance of electrical and electronic circuits.

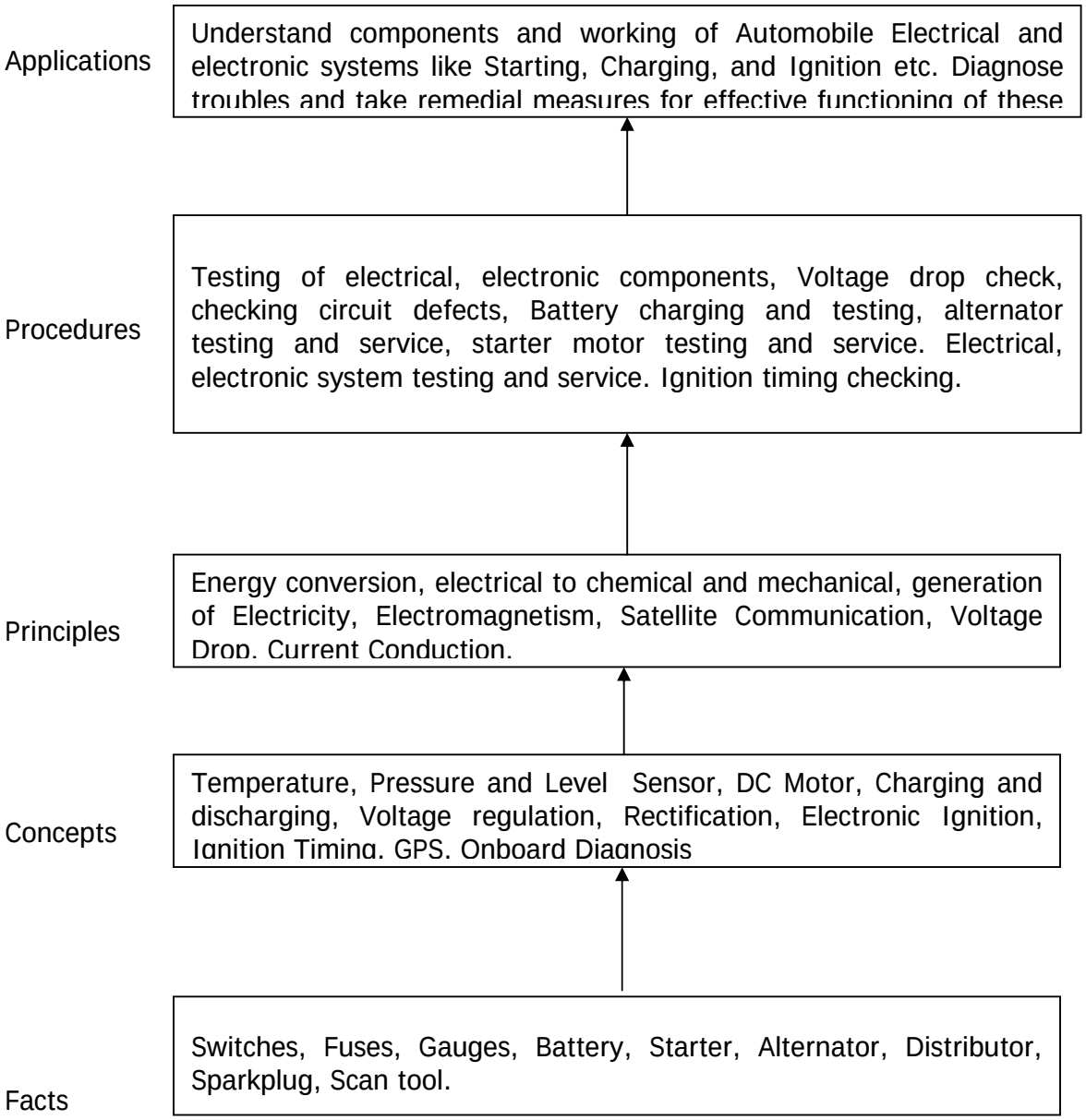
General Objectives:

Students will be able to:

1) Diagnose and repair the defects in the circuits, Know circuit protection devices and understand working of electromagnetic gauges as well as electrical accessories. Understand and apply onboard diagnosis.
2) Understand the purpose, construction, rating, testing of battery and major reasons of battery failure.

3) Identify components, operation and testing of starting, charging and ignition system.
4) Understand lighting system and accessories in modern vehicles.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Automotive Electrical and Electronic Components **Specific Objectives:** ➢ Understand the purpose, operations and applications of various Automotive Electrical and Electronic Components. ➢ Apply methods to test simple circuit defects. ➢ Understand working of electrical accessories and Gauges. **Contents:** **1.1** Purpose and operation of electrical components and circuit protection devices 08 Marks • Switches (SPST, SPDT, Ganged switch, mercury switch), • Relays, Solenoids, Buzzers, Resistors. • Fuses, Maxi fuses, Fusible links, Circuit breakers (Manual and automatic resetting types.) **1.2** Testing of circuit defects 04 Marks • Open circuit, Short circuit, Shorts to grounds, Voltage drop. **1.3** Working of Electromagnetic gauges and electrical accessories 08 Marks • Temp Gauges, Fuel gauge, Engine oil pressure gauge, Speedo-meter gauge • Washer pumps, Blower motor (only simplified wiring **/** block diagrams). • Electro chromic mirror, Power seat, Power window (only simplified wiring **/** block diagrams).	12	20
Topic 2: Automotive Battery **Specific Objectives:** ➢ Identify components of automotive battery. ➢ Understand working and types of batteries. ➢ Apply different tests on battery and judge causes of failure. ➢ Understand battery charging. **2.1** Battery: Types and Testing 08 Marks • Construction and Working of following types: Lead acid battery, Maintenance free battery, Low maintenance battery, Hybrid Battery • Battery ratings and specifications. • Battery terminal test, Leakage test, Specific Gravity Test, Open circuit test, Battery drain test. **2.2** Battery charging and Jump Starting 04 Marks • Initial charging procedure, Slow, fast rate charging and trickle charging. Precautions during charging. • Concept of dry charged battery.	09	16

• Jump starting-Procedure and precautions. **2.3** Factors affecting battery life and Battery failures 04 Marks • Cycle failure, internal short circuit, overcharging and sulphation. • Battery maintenance and safety precautions.		
Topic 3: Starting And Charging System **Specific Objectives:** ➢ Identify components of automotive starter and alternator. ➢ Understand working and draw labeled circuit diagram of starting system and charging system. ➢ Apply different tests on starter motor and alternator and judge reasons for failure. ➢ Know importance of output Voltage regulation. **Part A: Starting System 08 Marks** **3.1** Construction and working of starting system. **3.2** Types of starter drive: construction and working. • Bendix and overrunning clutch types only **3.3** Testing of starting system • Quick testing, Current draw test, Insulated circuit resistance test (voltage drop test), Ground circuit test, No crank test, free speed test.	05	20
Part B: Charging System 12 Marks **3.4** Construction and operation of alternator. Initial excitation and self excitation. **3.5** Alternator testing • Current output test, Field current draw test. Regulator output test, charging circuit resistance test (voltage drop test). **3.6** Alternator components testing • Rotor, Stator, Internal regulator and rectifier. **3.7** Regulation • Electronic, Computer Regulation circuit: layout and operation. **3.8** Operation of charge indicator light circuit with simple wiring diagram	08	
Topic 4 : Ignition System Specific Objectives: ➢ Identify components of ignition system and understand functions. ➢ Understand operation of modern ignition systems. **4.1** Conventional Ignition System- 06 Marks • Need of ignition system, working of different components (ballast resister, ignition coil, distributor, spark plug, cords and condenser). **4.2** Electronic ignition system- 12 Marks • Triggering of Primary circuit: Purpose, use of Transistor, Methods of triggering (magnetic pick up, Optical, Hall effect, HEI)	10	18

• Electronic spark timing (EST): operation and block diagram • Computer controlled ignition system: operation and block diagram • Distributorless ignition system: operation and block diagram • Sensors: List and functions of Crankshaft Position Sensor, Camshaft Position sensor, Detonation sensor, Cylinder Identification sensor] (No construction and working)		
Topic 5: Advanced Accessories Fundamentals **Specific Objectives:** ➢ Understand purpose and operation of advanced automotive accessories. ➢ Know latest technology and concepts used in automobiles. **5.1** Purpose and Operation of advanced accessories 08 Marks • Automatic headlight dimming. • Automatic on/off headlight with time delay. • Keyless entry system • Common anti-theft system • Automatic door lock system. • Park assists system. (No circuit diagram expected for above mentioned accessories) **5.2** Introduction to microprocessor, embedded system, and GPS (block diagram only), Use and working of fiber optics and its diagnosis. 06 Marks	10	14
Topic 6: Diagnosis of Electronic Components and Systems **Specific Objectives:** ➢ Apply methods to diagnose electronic sensors and actuators. ➢ Know features of OBD and OBD terms. ➢ Understand and identify troubles using malfunction indicator signal or diagnostic tester. ➢ Judge reasons of failure in electronic gauges. **6.1** Sensor construction, working and Testing 08 Marks • Oxygen sensor, Engine coolant sensor, Intake air temperature sensor, Throttle position sensor, Manifold absolute pressure sensor. • Electronic fuel Injector testing (Sound test, Ohmmeter test only) . **6.2** Onboard diagnosis (OBD) 04 Marks • Purpose of onboard diagnostic second generation • Flash codes of Malfunction indicator light. • OBD II Concept, terminology: Drive cycle, Trip, Warm up cycle (Definitions only) • SAE J2012 standards Diagnostic Trouble Code(DTC) :-5 digits only	10	12
Total	**64**	**100**

Practical:
Skills to be developed:

Intellectual Skills:

1. Understand the operations of Automotive Electrical and Electronic Components, working of electrical accessories.
2. Apply various test procedures for battery as specified by manufacturer.
3. Adopt the precautions while handling a battery.
4. Identify the alternator components, starter motor components and understand test procedure of some of the components.
5. Understand the test and service procedure for spark plug, distributor and spark plug cords.
6. Identify and locate sensors and understand diagnostic procedures (on-board and stand alone diagnosis).

Motor Skills:

1. Test electrical circuits for simple circuit defects. Measure parameters such as current, voltage drop using multi-meter.
2. Use hydrometer, use temperature correction factor.
3. Perform starter motor tests as specified by manufacturer.
4. Perform alternator tests and component tests as specified by manufacturer.
5. Use of stroboscope operation for ignition timing adjustment.

List of Practicals:

1. Testing of circuit defects like open, short, short to ground, voltage drop.
2. Battery Tests- Specific gravity of electrolyte, High rate discharge test of battery. Load test of battery, Open circuit test, Battery drain test.
3. Starter Motor –Component identification, dismantling and assembly.
   – Starter current draw test and voltage drop test.
4. Alternator- Component identification, dismantling and assembly.
5. Alternator- Output test, Regulated Voltage Output Test, Charging circuit resistance test.
6. Alternator- Electrical testing of rotor and stator of alternator
7. Checking ignition timing of a multi cylinder engine with strobe (neon light)
8. Inspection of spark plug cords, Servicing of spark plugs and distributor.
9. Industrial Visit: Demonstration of On-board diagnosis at nearby automobile workshop with necessary facility, write assignment on the same.

Note:

1. Practical's to be conducted in group of 3-4 students.
2. Use of Auto. Electrical test bench and Trainer kits is necessary.
3. A number of practicals may be initiated simultaneously.

List of Assignments:

1. Study and collect information of Location, construction and working of sensors and actuators. Use books, and websites. Printed data should be added to journal
2. Write symptoms, causes and remedies for Troubles of electronic gauges like.
   - Gauge reads low constantly.
   - Gauge reads high constantly.
   - Inaccurate Gauge reading

Learning Resources:

1. **Books:**

Sr. No.	Author	Title	Publisher / Edition
01	Jack Erjavec, Robert Scharff	Automotive Technology: A System Approach	Delmar Publisher Inc
02	Anthony E Schwaller	Motor Automotive Technology	Delmar Publisher Inc. 3rd Edition
03	Barry Hollenbeck	Automotive Electricity, Electronics and Computer Controls	Delmar Publishers

2. **IS, BIS and International Codes:** SAE J 2012 Standards
3. **Websites:** www.how stuff works.com,
   www.educypedia.be
   www.autoshop101.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. • Linking of previous knowledge with the new topic. • Creating interest among the students.	5 to 10 Minutes
2.	Development	• Content Delivery (should be such that the interest should be created & sustained among the students) • Giving analogy for the abstract concepts. • Giving examples from the world of work. • Solving numerical problems. • Asking questions to the students. • Involving students in the teaching learning process.	40 to 50 Minutes
3.	Consolidation	• Summarizing the lecture. • 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

Automotive Electrical and Electronic Components

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.

Knowledge Category	Example/s of category	Teaching methodology
FACT	Switches, Fuses, Gauges, Relays, Solenoids, Circuit Breakers.	Show the various components. Make use of PPTs for better understanding of students.
CONCEPT	Temperature, Pressure, Current, Voltage	Explanation with chalk & board initially. Make use of PPTs.
PRINCIPLE	Voltage Drop, Current Conduction, Energy Conversion	Explanation with chalk & board initially. Make use of PPTs.
PROCEDURE	Testing of electrical Components, testing of circuit defects	Demonstrate through models/PPT/Actual components.
APPLICATION	Starting system, Headlights, Horns, Fuel Injectors, dashboards, Cooling system.	Demonstrate through models/PPT/Actual components.

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

Title:
1) Automotive technology: A System Approach by Jack Erjavec, Robert Scharff, Delmer publisher Inc.
2) Motor Automotive Technology by Anthony E Schwaller, Delmer publisher Inc.
3) Automotive Electricity, Electronics and computer controls by Barry Hollenback, Delmer publisher Inc.

Teaching Aids: Charts and models of Switches and relays, solenoids fuses and circuit breakers. Charts and models of electrical accessories.

PPTs: Construction and working of electromagnetic gauges and electrical accessories.

Websites www.slideshare.net
www.howstuffworks.com

<table>
<tr><td></td><td>www.autoshop101.com
www.educypedia.be</td></tr>
<tr><td>Lecture No.</td><td>Topic/ Subtopic to be covered</td></tr>
<tr><td>1</td><td>Purpose and operation of electrical components like switches(SPST, SPDT, GANGED SWITCH, MERCURY SWITCH) ,</td></tr>
<tr><td>2,3</td><td>Relays, Solenoids, buzzers, and resistors.</td></tr>
<tr><td>4</td><td>Purpose of circuit protection devices like fuses, maxi fuses,</td></tr>
<tr><td>5</td><td>Circuit breakers (Manual and automatic resetting types.) and fusible links</td></tr>
<tr><td>6</td><td>Testing of circuit defects like open circuit, shorts,</td></tr>
<tr><td>7</td><td>Shorts to grounds, voltage drop.</td></tr>
<tr><td>8</td><td>Working of Electromagnetic gauges like temp Gauges, fuel gauge</td></tr>
<tr><td>9</td><td>Engine oil pressure gauge, Speedo-meter gauge.</td></tr>
<tr><td>10</td><td>Working of electrical accessories like washer pumps and blower motor (only simplified wiring / block diagrams)</td></tr>
<tr><td>11</td><td>electro chromic mirror, (only simplified wiring / block diagrams)</td></tr>
<tr><td>12</td><td>Power window, power seat, (only simplified wiring / block diagrams)</td></tr>
<tr><td>Topic 2</td><td>Automotive Battery

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.

<table>
<tr><th>Knowledge Category</th><th>Example/s of category</th><th>Teaching methodology</th></tr>
<tr><td>FACT</td><td>Lead acid battery, maintenance free battery, Hybrid battery, and low maintenance battery.</td><td>Show the various types of batteries and its components. Make use of PPTs for better understanding of students.</td></tr>
<tr><td>CONCEPT</td><td>Temperature, Specific gravity, voltage and current.</td><td>Explanation with chalk & board initially. Make use of PPTs. And charts.</td></tr>
<tr><td>PRINCIPLE</td><td>Energy conversion from</td><td>Explanation with chalk & board initially. Make</td></tr>
</table>
</td></tr>
</table>

		chemical to electrical.	use of PPTs. Explain chemical equation for battery charging and discharging.
	PROCEDURE	Battery charging and battery testing and jump starting.	Demonstrate through PPT/Actual components.
	APPLICATION	Understand components and working of Automotive batteries. Diagnose troubles of various batteries.	Demonstrate through PPT/Actual components.

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

Books:

Title:

1) Automotive technology: A System Approach by Jack Erjavec, Robert Scharff, Delmer publisher Inc.

2) Motor Automotive Technology by Anthony E Schwaller, Delmer publisher Inc.

3) Automotive Electricity, Electronics and computer controls by Barry Hollenback, Delmer publisher Inc.

Teaching Aids: Charts and cut sections of batteries.

PPTs: Construction and working of batteries. Videos for battery test.

Websites www.slideshare.net

www.howstuffworks.com

www.autoshop101.com

www.educypedia.be

Lecture No.	Topic/ Subtopic to be covered
1,2	• Construction and Working of following types: Lead acid battery, Maintenance free battery, Low maintenance battery, Hybrid Battery
3	• Battery ratings and specifications.
4,5	• Battery terminal test, Leakage test, Specific Gravity Test, Open circuit test, Battery drain test.
6	• Initial charging procedure, Slow, fast rate charging and trickle charging. Precautions during charging.
7	• Concept of dry charged battery.

	• Jump starting-Procedure and precautions.
8	• Cycle failure, internal short circuit, overcharging and sulphation.
9	• Battery maintenance and safety precautions.

Topic 3

Starting and Charginmg System.

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	Self starter, Alternator, Voltage Regulator, Starter drives.	Show the various components. Make use of PPTs for better understanding of students.
CONCEPT	DC Motor, Charging, Voltage Regulation, Rectification.	Explanation with chalk & board initially. Make use of PPTs.
PRINCIPLE	Electromagnetism, Generation of electricity, Energy conversion from mechanical to electrical and viceversa.	Explanation with chalk & board initially. Make use of PPTs.
PROCEDURE	Testing and servicing of charging system and starting systems.	Demonstrate through PPT/Actual components.
APPLICATION	Understand components and working of Automotive charging and starting systems. Diagnose troubles of these systems.	Demonstrate through PPT/Actual components. Videos and animations should be used.

Learning Resources: Books , Charts ,Models and PPTs, videos and animations.

Books:

Title:

1) Automotive technology: A System Approach by Jack Erjavec, Robert Scharff, Delmer publisher Inc.

	2) Motor Automotive Technology by Anthony E Schwaller, Delmer publisher Inc. 3) Automotive Electricity, Electronics and computer controls by Barry Hollenback, Delmer publisher Inc. **Teaching Aids**: Charts and models of alternator and self starter and their components. **PPTs:** Construction and working of alternator and self starter. **Websites** www.slideshare.net **www.howstuffworks.com** www.autoshop101.com www.educypedia.be
Lecture No.	Topic/ Subtopic to be covered
1	Construction and working of starting system.
2	Types of starter drive: construction and working. • Bendix drive.
3	Types of starter drive: construction and working. overrunning clutch.
4	Testing of starting system Quick testing, Current draw test, Insulated circuit resistance test (voltage drop test).
5	Testing of starting system Ground circuit test, No crank test, free speed test.
6	Construction and operation of alternator.
7	Initial excitation and self excitation.
8	Alternator testing • Current output test, Field current draw test.
9	Alternator testing • Regulator output test, charging circuit resistance test (voltage drop test).
10	Alternator components testing • Rotor, Stator, Internal regulator and rectifier.
11	Regulation • Electronic, Regulation circuit: layout and operation.
12	Regulation • Computer Regulation circuit: layout and operation.

13	Operation of charge indicator light circuit with simple wiring diagram

Topic 4

Ignition Systems

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

Knowledge Category	Example/s of category	Teaching methodology
FACT	Distributor, Ignition coil, Spark plug, condenser, Sensors, microprocessor.	Show the various components. Make use of PPTs for better understanding of students.
CONCEPT	Ignition Timing, Hall effect, optical method,	Explanation with chalk & board initially. Make use of PPTs.
PRINCIPLE	Electromagnetism, Mutual Induction, current conduction.	Explanation with chalk & board initially. Make use of PPTs.
PROCEDURE	Testing and servicing of Ignition system and its components, Ignition timing checking	Demonstrate through PPT/Actual components.
APPLICATION	Understand components and working of Automotive ignition systems. Diagnose troubles of ignition systems.	Demonstrate through PPT/Actual components. Videos and animations should be used.

Learning Resources: Books , Charts ,Models and PPTs, videos and animations.

Books:

Title:

1) Automotive technology: A System Approach by Jack Erjavec, Robert Scharff, Delmer publisher Inc.

2) Motor Automotive Technology by Anthony E Schwaller, Delmer publisher Inc.

3) Automotive Electricity, Electronics and computer controls by Barry Hollenback, Delmer publisher Inc.

Teaching Aids: Charts and models of ignition systems and its components.

	PPTs: Construction and working of ignition systems. **Websites** www.slideshare.net **www.howstuffworks.com** www.autoshop101.com www.educypedia.be
Lecture No.	Topic/ Subtopic to be covered
1,	Need of Ignition system,
2,3	working of different components.(ballasr registor, ignition coil, distributor, spark plug, cords and condenser.)
4,	Triggering of Primary circuit – Purpose, use of transistor.
5,6	methods of triggering (Magnetic pick up, Hall Effect, HEI and Optical method.
7	Electronic spark timing(EST): OPERATION AND BLOCK DIAGRAM
8	Computer controlled ignition system: OPERATION AND BLOCK DIAGRAM
9	Distributor less ignition system: OPERATION AND BLOCK DIAGRAM
10	Sensors: list and function of Crankshaft position sensor, camshaft position sensor, detonation sensor, cylinder identification sensor.

Topic 5 **Advanced Accessories Fundamentals**

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	Microprocessor. fibre optics, Headlight,	Show the various components. Make use of PPTs for better

	Automatic door lock systems.	understanding of students.
CONCEPT	GPS, Embedded system, Keyless entry system	Explanation with chalk & board initially. Make use of PPTs.
PRINCIPLE	Satellite communication, Photocell,	Explanation with chalk & board initially. Make use of PPTs.
PROCEDURE	Testing and servicing of advanced automotive accessories and fibre optics.	Demonstrate through PPT/Actual components.
APPLICATION	Understand components and working of Automotive advanced accessories.	Demonstrate through PPT/Actual components. Videos and animations should be used.

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

Title:
1) Automotive technology: A System Approach by Jack Erjavec, Robert Scharff, Delmer publisher Inc.
2) Motor Automotive Technology by Anthony E Schwaller, Delmer publisher Inc.
3) Automotive Electricity, Electronics and computer controls by Barry Hollenback, Delmer publisher Inc.

Teaching Aids: Charts and models of advanced accessories.

PPTs: Construction and working of advanced accessories.

Websites www.slideshare.net
www.howstuffworks.com
www.autoshop101.com
www.educypedia.be

Lecture No.	Topic/ Subtopic to be covered
1,	Purpose and operation of Automatic headlight dimming

2	Purpose and operation of Automatic on/off headlight with time delay.
3	Purpose and operation of keyless entry system.
4	Purpose and operation of common antitheft system.
5	Purpose and operation of Automatic door lock systems.
6	Purpose and operation of park assist system.
7,8	Introduction to microprocessor, embedded system,GPS (block diagram only).
9,10	Use and working of fibre optics and its diagnosis.

Topic 6 **Diagnosis of Electronic Components and systems:**

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

Knowledge Category	Example/s of category	Teaching methodology
FACT	Sensors, scan tool, Electronic fuel injector, MIL	Show the various components. Make use of PPTs for better understanding of students.
CONCEPT	sound, resistance, flash codes, DTC,	Explanation with chalk & board initially. Make use of PPTs.
PRINCIPLE	On Board Diagnosis II.	Explanation with chalk & board initially. Make use of PPTs.
PROCEDURE	Testing and diagnosis of automotive sensors and actuators.	Demonstrate through PPT/Actual components.
APPLICATION	Understand and Diagnose the On Board Diagnosis second	Demonstrate through PPT/Actual components. Videos and animations should be used.

		generation.	

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

Title:
1) Automotive technology: A System Approach by Jack Erjavec, Robert Scharff, Delmer publisher Inc.
2) Motor Automotive Technology by Anthony E Schwaller, Delmer publisher Inc.
3) Automotive Electricity, Electronics and computer controls by Barry Hollenback, Delmer publisher Inc.

Teaching Aids: Charts of Sensors, concept of OBDII and DTC.

PPTs: Sensors, concept of OBDII and DTC.

Websites www.slideshare.net
www.howstuffworks.com
www.autoshop101.com
www.educypedia.be

Lecture No.	Topic/ Subtopic to be covered
1,	Construction, working and testing of Oxygen sensor.
2	Construction, working and testing of Engine coolant sensor.
3	Construction, working and testing of Intake air temperature sensor.
4	Construction, working and testing of Throttle position sensor.
5	Construction, working and testing of Manifold absolute pressure sensor.
6	Construction, working and testing of Electronic fuel injector. (Sound test and Ohmmeter test)

7,8	Purpose of Onboard Diagnostic second generation. Flash codes of Malfunction Indicator light.
9,10	OBD II Concept, terminology: Drive cycle, Trip, Warm up cycle. SAE J 2012 standard diagnostic trouble code (DTC): 5 digits only.

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:

\Strategy for conduction of Experiment No. 07

Instruction to Teacher

1. Teacher should explain the layout of ignition system.
2. He should ask the students to take certain precaution as regards the
   a. High voltage circuit
   b. Preventing admission of dirt in the engine cylinder.
   c. Keeping hands off the rotating parts, even it appears to be stationary.
   d. Make sure that the hood is secure with hood stay rod.
   e. Whenever you conduct a task checking ignition timing you must use personal protective clothing and equipments.
3. Teacher shall explain the procedure of checking ignition timing using timing light. He should draw schematic diagram on board and explain it.
4. We should ask students to perform certain tasks like making the removing plug and covering the spark plug well etc., making electrical connection and holding timing light and aiming it at proper place and note the observation.

Title : Check Ignition Timing of a multi cylinder engine with strobe (neon light)

Prior concept: Persistence of vision, TDC mark on the crankshaft pulley.

New Concept: Ignition Timing, Timing light (strobe).

Instructions to be given to students
Precautions

i. Different manufacturers number their cylinders from different ends of the engine, so check the workshop manual if you are not sure which the number one cylinder is.
ii. Locate the crankshaft and spark plug.
iii. While handling spark plug, spark plug cap and its chord ensure that the engine is in the off condition and allowed to cool.
iv. Locate the position of the timing marks. These are normally on the front of the engine on the crankshaft pulley or harmonic balancer with a corresponding mark on the engine block.
v. Locate the number one cylinder spark plug.
vi. Attach the timing light cable on to the high tension lead leading to the number one cylinder.
vii. Then connects the power leads to the battery red lead to the positive terminal, black to the negative terminal.
viii. Start the engine and see that the same has reached to the normal operating temperature.
ix. After that check whether the stationery pointer is opposite to the specific mark.
x. Caution: Ask students to keep their hands and tools off the rotating parts.
xi. Crank the engine with ignition switch in ON condition. Aim the timing gun flashes at the reference mark and timing marks of the engine.
xii. Apron, belt and shoes should be made compulsory for the practical.

Questions

1. Describe the concept of persistence of vision.
2. Describe significance of correct ignition timing.
3. State the necessity of ignition advance.
4. List tools and equipment used in conduct of experiment.

In the similar way strategy for other practical may be prepared.

5.4.1 Laboratory Manuals: Purpose and Utility:
5.4.2 Suggestions for effective conduct of practical and assessment:
5.4.3 Preparation for conduct of practical

6. Mode of assessment:

6.1.1 Class Test:

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

6.1.2 Sample Test Papers:

Sample Test Paper 1

Roll No.				

Subject Code17617

Course Name: Diploma in Automobile Engineering . Course Code: AE

Semester: Sixth

Subject**: Automotive Electricals and Electronics System**

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 of the following **3x3=9**

a) State the functions of following electrical components.

i) Relays ii) solenoids

b) List any six components of lead acid battery.

c) State the principle of operation of alternator.

d) Describe the construction and working of electromagnetic oil pressure gauge.

Q2. Attempt any Two of the following **4x2=8**

a) State the purpose of fusible links and maxi fuses with neat sketch.

b) Describe fast rate charging and trickle charging.

c) Draw the labeled sketch of bendix drive and describe its working.

Q3. Attempt any Two of the following **4x2=8**

a) Describe open circuit defect test with neat sketch.

b) Describe battery drain rest with suitable sketch..

c) How will you identify the electrical and mechanicalproblem in the starting motor by using free speed test.

6.1.2 Sample Test Papers:

Sample Test Paper 2

Roll No.				

Subject Code17617

Course Name: Diploma in Automobile Engineering . Course Code: AE

Subject**: Automotive Electricals and Electronics System**

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 of the following 3x3=9

a. State the need of ignition system..

b. State the use of fibre optics in automobile.

c. Define: i. Trip ii. Drive cycle. Iii. Warm up cycle.

d. Describe the operation of electronic spark timing with block diagram.

Q2. Attempt any Two of the following 4x2=8

a. Describe optical method of triggering of primary circuit with neat sketch.

b. Describe the operation of park assist system.

c. Describe the construction and working of oxygen sensor.

Q3. Attempt any Two of the following 4x2=8

a. State functions of camshaft position sensor and cylinder identification sensor.

b. State the importance of microprocessor in automobile.

c. How ohmmeter test of an electronic fuel injector is done?

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

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

6.2.1.3 Reliability

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

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

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

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

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

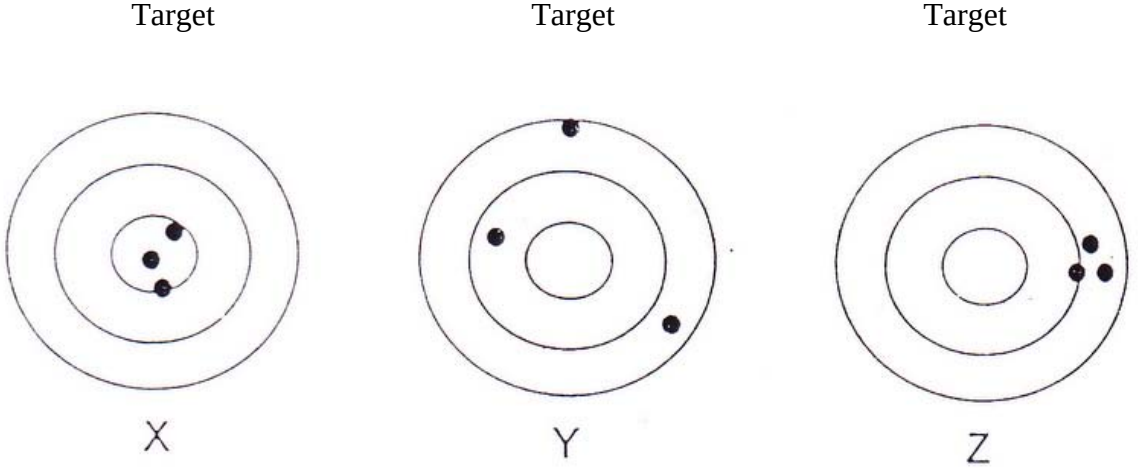
ii) **Examiners Objectivity**

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

iii) **Number of Questions**

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

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



Reliable & Valid | Unreliable & Invalid | Reliable but invalid

Shooting Shooting 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.

Exam Seat No.									

17617

Maharashtra State Board of Technical Education
Sample Question Paper

Course Name: Automobile Engineering Course Code: AE 6G

Semester: SIXTH

Title of the Subject: Automotive Electricals and Electronics Systems Subject Code: 17617

Marks: 100 Times: 3 Hours.

Q.1 A) ATTEMPT ANY THREE **12 MARKS**

a) State the purposes of following electrical components.

i) Buzzers ii) Resistors

b) Define battery ratings and state its types.

c) State types and functions of starter drives.

d) List four components of conventional ignition system and state their functions.

Q.1 B) ATTEMPT ANY ONE **6 MARK**

a) Draw a neat labeled sketch of electromagnetic fuel gauge and describe its construction and working.

b) State precautions to be taken while jump starting and describe the procedure with neat sketch.

Q.2 ATTEMPT ANY FOUR **16 MARK**

a) State the types and functions of switches.

b) List the various circuit defects and describe working of short circuit with suitable sketch.

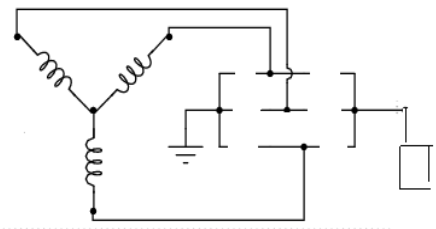
c) Answer the following:

i) Identify the figure.

ii) Redraw the figure with correct position of missing components

iii) label all the components.

iv) Show the direction of current.



d) Draw the wiring diagram of power window circuit and describe its working.

e) Define relay and solenoid used in automobile. Draw neat labeled sketch of relay.

f) Draw the block diagram of starting system and describe its working.

Q.3 ATTEMPT ANY FOUR **16 MARK**

a) List common antitheft systems used in modern automobiles. Describe any one in brief.

b) State the purpose of OBD II. Define the terms drive cycle and trip.

c) Describe working of automatic resetting type circuit breaker with neat sketch.

d) State the purpose of following components used in ignition system.

i) Spark plug ii) distributor iii) condenser iv) ballast resistor.

e) State the functions of i) crankshaft position sensor ii) detonation sensor.

Q.4 A) ATTEMPT ANY THREE **12 MARKS**

a) Describe the operation of automatic door lock system.

b) State the salient features of keyless entry system.

c) Describe the construction and working of throttle position sensor.

d) Describe DTC structure as detected by SAE J 2012.

B) ATTEMPT ANY ONE **06 MARKS**

a) Describe the operation of charge indicator light circuit with simple wiring diagram.

b) How are the hydrometer and digital voltmeter used to check the state of charge of automotive battery?

Q.5 ATTEMPT ANY FOUR **16 MARKS**

a) Draw the block diagram of GPS and label it.

b) Describe the operation of automatic ON/OFF head light with time delay.

c) What are the causes and troubles from battery overcharging and undercharging?

d) Write the procedure for sound test for testing electronic fuel injector.

e) How alternator voltage and current output are controlled? Describe.

f) Describe the procedure for testing alternator rotor and stator with neat sketch.

Q.6 ATTEMPT ANY FOUR **16 MARKS**

a) Describe construction and working of maintenance free batteries.

b) How voltage drop test can help to locate starting system troubles?

c) Differentiate between conventional and electronic ignition systems.

d) How does Hall Effect switch operate? Describe with neat sketch.

e) Describe operation of distributor less ignition system with block diagram.