CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR

APPLIED SCIENCE-PHYSICS

(17207)

Civil Engineering Group

'G Scheme'
SECOND SEMESTER

JANUARY 2013

MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION, Mumbai

CURRICULUM DEVELOPMENT CELL, MSBTE, MUMBAI.

TEACHER'S GUIDE AND SAMPLE QUESTION PAPER

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1. APPROACH TO CURRICULUM DESIGN

1.1 INTRODUCTION

Maharashtra State Board of Technical Education is an autonomous organization since April 1999. The main activities of the board are to design the curricula of Diploma and post diploma courses and conduct examinations. Further the Board develops appropriate learning resources – print and non-print – to be used by the students. In order to ensure the quality of education, monitoring of institutions is carried out normally two times in a year. Teachers are the backbone of technical education system and hence efforts are made by the board to provide training opportunities to the teachers. Presently industrial training is arranged for the teachers through Maharashtra Economic Development Council (MEDC). Teachers and supporting staff are also deputed for training organized by National Institute of Technical Teachers Training and Research, Bhopal.

During last five years there has been remarkable change in the industrial scenario. The expectations of present and future industries indicate the changed role of a diploma engineer. It is therefore necessary to redefine the job profile of diploma engineer. This revised job profile will be useful in revising the curriculum.

The basic principle while designing or revising any curriculum is to identify needs of user industries. This data and its analysis help in deciding curriculum objectives and further enable to select appropriate subjects.

Therefore Industry Survey to identify the present and future needs of industry was conducted in July 2011 by the committee appointed for curriculum revision.

For the purpose of revising the curriculum Project Institutes were identified. A team of Coordinators, Core group members and Subject Experts was formed to execute the revision. The team members were identified from various Government, Government Aided and Private Polytechnics.

Training in Curriculum Development of faculty members involved at various levels was conducted. The core group members visited a number of industries to have first hand knowledge about the expectations of industries from diploma passouts. Industry experts were involved at all the stages of curriculum revision and validation.

The details related to curriculum philosophy, curriculum model, curriculum objectives, desired skills, link diagram, salient features and implementation strategy are given below

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.

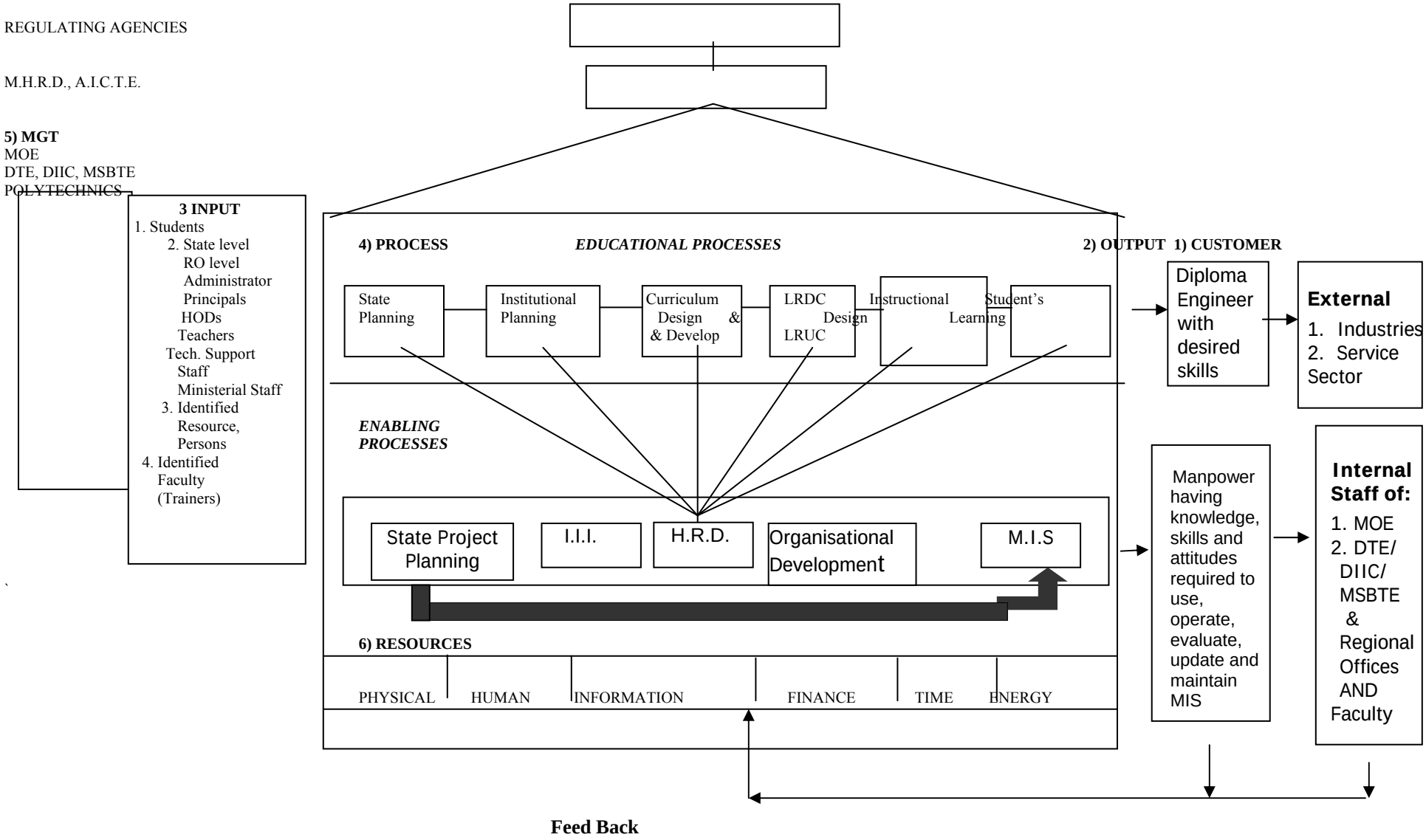


Fig 1 Systems Approach

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

"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.

Following are the key points in the philosophy:

- Job profile of middle scale industries is considered to design the curriculum including service industries
- Dimensions of curriculum revision are:
  - Individual development
  - Social development
  - Technology development
  - Continued learning
- Subjects for the course are classified as follows
  - Basic sciences
  - Engineering sciences
  - Human sciences
  - Core technology
  - Technology
- Link diagram shows the relationship of various subjects at different categories which helps in deciding the appropriate contents of the subjects
- Practical focuses on development of cognitive skills and psychomotor skills

1.3 Curriculum Development Model:

Following are the major steps used for designing the content and subsequent approval:

- Entry Behavior
- User need assessment
- Teacher Training for Curriculum Development
- Industry Involvement

- Validation

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.

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:

- Communication skill
- Team work
- Problem solving
- Leadership
- Decision Making
- Presentation skills
- Report writing skills
- Interpersonal skills
- Information search

Technological Skills:

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

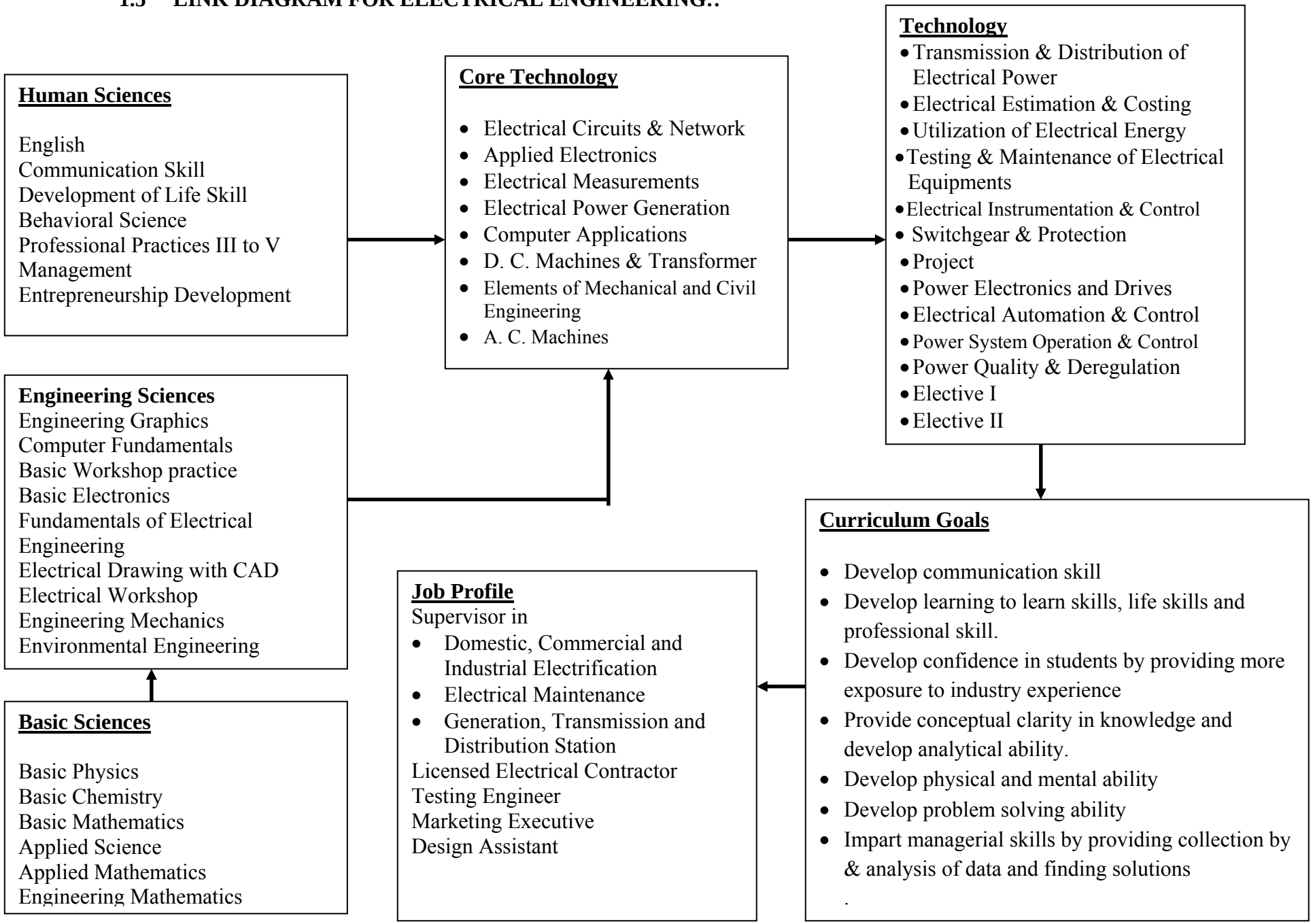
Intellectual Skills:

- Use of data sheets, charts, handbooks, standards
- Interpret drawing, circuit diagrams, plant layouts, charts, performance analysis
- Select materials and components
- Locate faults and repairs of faults
- Analyse the data
- Prepare Estimate
- Design of simple components
- Use of computer software

Motor Skills:

- Measure accurately different parameters
- Operate machines
- Calibrate instruments
- Repair Faults
- Install machines
- Draw plant layout and Prepare detailed drawing
- Conduct various tests and Draw charactoristics

1.5 LINK DIAGRAM FOR ELECTRICAL 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 Basic Model of Learning

The basic model of learning is as shown below:

GENERIC DIAG. – Stimulus and Response

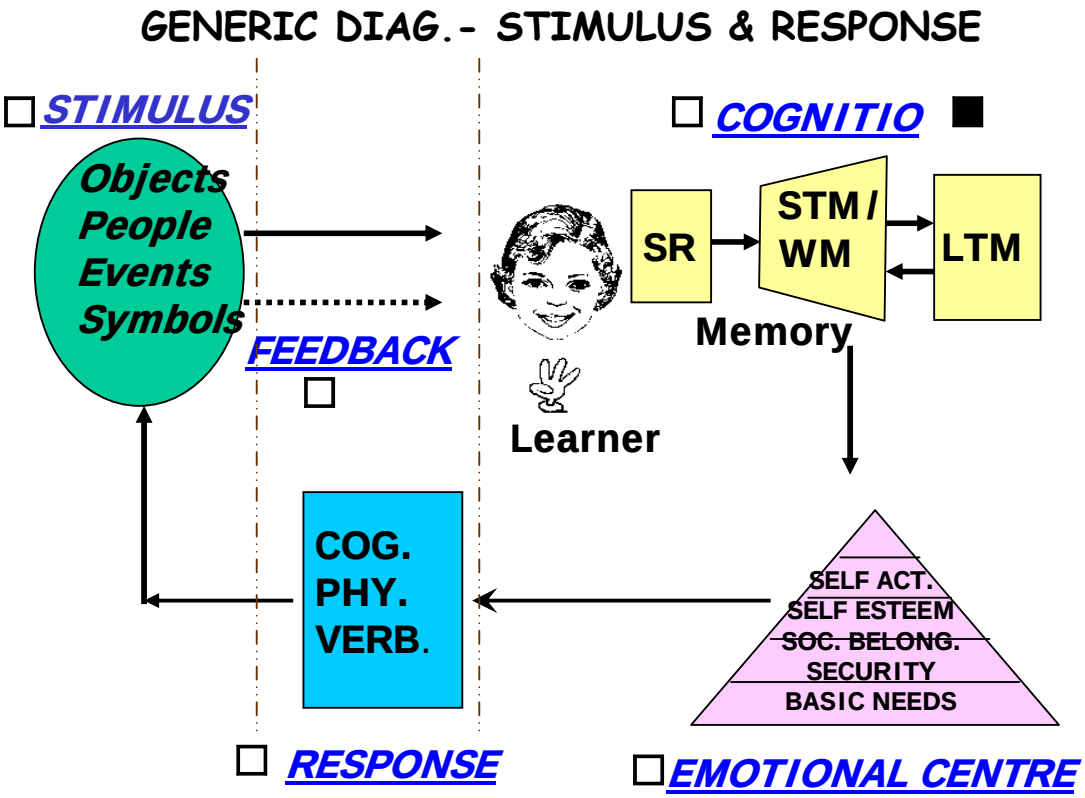


Fig. 2: Generic Diagram of Learners.

Stimulus: The information is received by senses from many things in surroundings. It activates senses for experience. It is called as stimulus. It. includes people, objects, events, symbols etc. For example: teachers, friends, instruments, drawings, text etc are stimulus for students.

Cognition: Cognition is the act of knowing. It deals with mental activities of the learner. It is triggered due to stimulus. It involves memory, its components structure of knowledge in memory and various processes in memory. The study of the same is done to know how learning takes place.

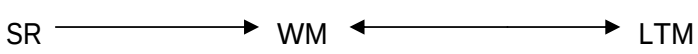
Emotional Centre: Stimulus may be pleasant or unpleasant feelings. It decides whether learner will approach to stimulus situation or avoid it. This is the effect of emotions of learners in emotion centre.

Response: When stimulus stimulate the learner reacts. This response may be mental response like reflection of face (cognition), physical movement (motor skills) or verbal response like communication. The response always aims at changing the stimulus situation.

Feedback: When teacher asks the question, you answer it. Then based on the content of the answer, teacher says whether it is 'correct' or 'wrong'. This is feedback. Thus it may be the information about the changed stimulus situation provided after response by the learner. Feedback helps learner to compare changed stimulus to expected change in stimulus.

Basic Concepts: Different forms used in the study of memory and its working are as below:

- **Memory:** It is the ability to recall the information, which has been previously learnt through experience. In context of memory structure, it is the location learned information is stored.
- **Storage:** It is process of putting information in the memory.
- **Encoding:** In memory, the information is not stored in original form but in numerical form, verbal form, visual images etc. Encoding is the process of modifying information from one form to another form. It helps to store information easily. It also stores new information to existing knowledge.
- **Retrieval:** It is the process to find the information that is previously stored in the memory so that it can be put to use.
- **Components of Memory:** The most prevalent view of human memory states that memory has three distinct components viz.
  - **Sensory Register (SR)**
  - **Working Memory (WM) or Short Term Memory (STM)**
  - **Long Term Memory (LTM)**
- **Control Process:** This is the process of movement of information from one memory component to another memory component.



- **Perception:** It is the final image formed in WM after processing the information from SR and LTM. The final image consists of visual image supported by elaboration and emotional content.

2.3 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.

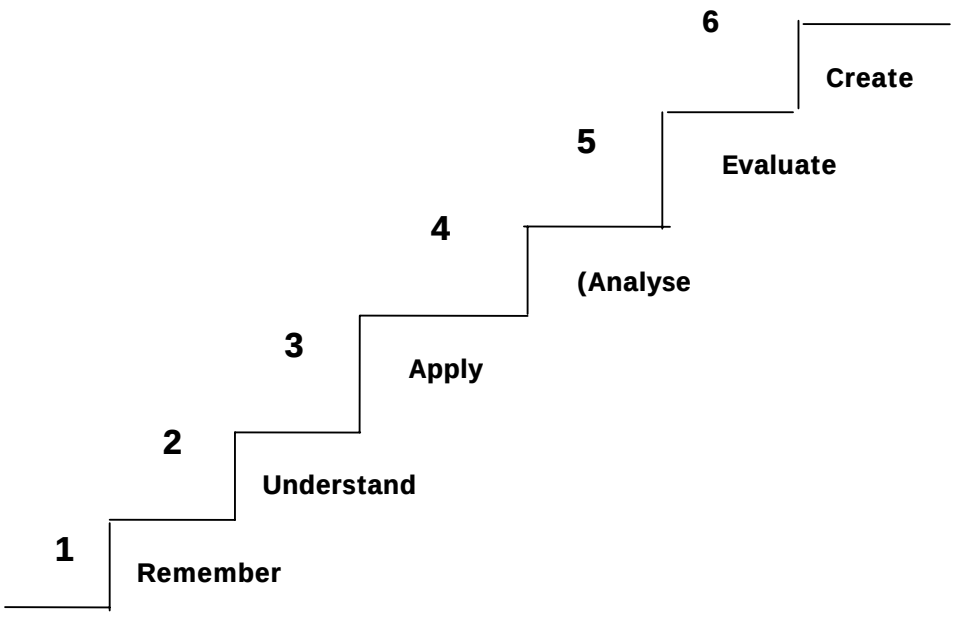
How far a student has developed these abilities/skills especially from cognitive and psychomotor domains is assessed on the basis of suitable examinations. When classroom and laboratory teaching is viewed in this light, evaluation becomes an integral part of teaching – learning process.

2.4 LEVELS OF LEARNING:

Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for the purpose of writing objectives and assessment. Dr. Bloom's revised taxonomy is based on cognitive psychology and is two dimensional. First dimension is cognitive process dimension ad other is knowledge dimension. Details of these two dimensions are given below.

2.4.1 Cognitive Domain:

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



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

Description of the Major Levels in the cognitive Domain (Bloom's Taxonomy)	Illustrative General Instructional Objectives	Illustrative verbs for stating specific learning outcomes
Remember – Knowledge is defined as the remembering of previously learned material. This may involve the recall of a wide range of material, from specific facts to complete theories, but all that is required to mind of the appropriate information. This represents the lowest level of learning outcomes in the cognitive domain	Knows common terms, specific facts, basic concepts, principles, methods & procedures	Define, describe, identify label, list, match, name, outline, reproduce, select, state
Understand – This is defined as the ability to grasp the meaning of material. This may be shown by translating material from one form to another (words or numbers) by interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects). Draw sketches these learning outcomes go one step beyond the simple remembering of material and represent the lowest level of understanding.	Understands fact, principles Interprets verbal material, Interprets charts, tables, graphs. Translates verbal material to mathematical formula. Estimates consequences implied in data. Justifies	Convert, distinguish estimate, explain, extend, generalize, give examples; infer, paraphrase, predict, rewrite, summarize, draw labeled sketches.

	methods & procedures.	
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.

Importance of the subject is on two counts:

One the knowledge gained while studying the subject helps understand and develop further knowledge of the subject or understand and effectively learn the higher level subjects.

The other indicates how the knowledge gained can be used in the world of work to perform given tasks.

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

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

Objectives indicate what is achievable and hence gives direction ot 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 in Cognitive Domain knowledge is divided in four components Factual, Conceptual, Procedural and Metacognitive. Of this Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the applications. Learning structure gives broad idea of these components for a subject. It indicates the scope of the subject. Normally we first decide what we want to achieve by studying the subject, which forms the application component. Based on this we decide what procedures are required for these 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.

One has to be careful in allotting the hours required to teach the topics looking at the importance of the topic for development of the subject. There fore it is necessary to provide sufficient time to teach concepts and principles so that they are well understood by the students as they form the basis for development of the subject.

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 there should not be any study type experiment as it is nothing but repetition of what is taught in the theory class. 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 fulfill the objectives of the entire curriculum

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 leaching 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 syllabus, 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 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 (I 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. Course Name : Civil Engineering Group

Course Code : CE/CS/CR/CV

Semester : Second

Subject Title : Applied Science (Physics)

Subject Code : 17207

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
02	--	02	02	50	25@	--	--	75

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)**
- **Applied Science is divided into two parts - Applied Science (Physics) and Applied Science (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 Applied Science. Similarly it is also applicable to practical examination. It is mandatory to appear theory and practical examination of both parts. Remaining absent in any examination of any part will not be declared successful for that examination head**.

Rationale:

Applied physics is a powerful instrument in engineering & technology. It is an important subject for mechanical engineering group courses

The topics on Rectilinear and Angular motion, kinetics and work power energy will be useful in understanding concepts of motion, velocity, impulse and applications such as recoil of gun, motion of lift, potential, kinetic energy, torque etc.

The topics on projectile and circular motion will be useful in various applications in civil, engineering field.

The topics on non destructive testing will be useful in testing various materials used in the civil, mechanical and automobile engineering field.

The topics on acoustics are useful for the students of civil engineering while designing auditoriums, lecture hall etc. Indoor lighting is necessary in architecture and interior design of a hall.

Principle of Photocell and its applications are required in study of solar cells, photovoltaic cells. The study of this subject matter will make the student versatile, innovative, & sound base for engineering studies & research work in technical field.

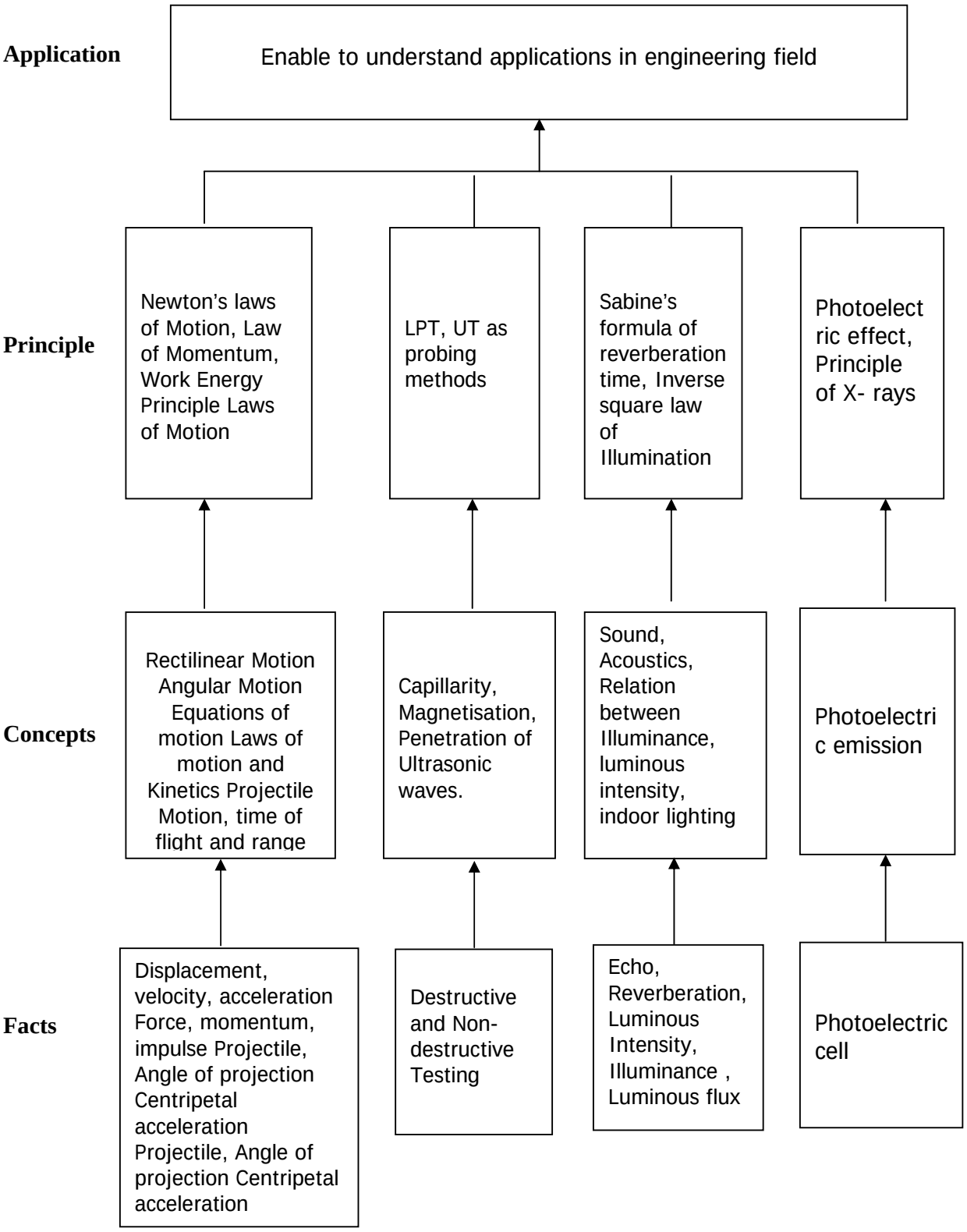
General Objectives.

Students will able to.

1. Understand equations of motion and their applications.
2. Differentiate kinetic and kinematics and solve the problems on kinematics and kinetics.
3. Understand Ultrasound and its applications
4. Use N.D.T. in quality assurance and saving of man power, machining, materials,
5. Use principles of illumination for enhancing work efficiency
6. Analyze variation of sound intensity with respect to distance.

7. Identify different factors affecting acoustical planning of buildings and indoor lighting.
8. Differentiate between Centripetal and Centrifugal force.

Learning Structure:



Applied Physics (Civil Engineering Group) Theory:

Topics and contents	Hours	Marks
Topic 1] Motion **Specific Objectives:** ➢ State equations of motion. ➢ Apply laws of motion to solve problems. ➢ Differentiate between linear and circular motion, ➢ State meaning of centripetal acceleration, centripetal force, **1. 1 Rectilinear and Angular Motion [06 Marks]** • Equations of motion:-V=u+at, $S=ut+1/2at^2$, $V^2=u^2+2as$ (no derivation), distance traveled by particle in n^{nt} second, (only equation), Uniform velocity, uniform acceleration and uniform retardation, equations of motion for motion under gravity. • Definition of angular displacement, angular velocity, angular acceleration, relation between angular velocity and linear velocity, three equations of angular motion (no derivation) angular distance traveled by particle in n^{nt} second (only equation). **1.2 Kinetics and Work Power Energy [06 Marks]** • Definitions of momentum, impulse, impulsive force with formulae, statements of Newton's laws of motion with equations, applications of laws of motion—recoil of gun. • Definition of work, power and energy, equations for potential energy. kinetic energy, work -energy principle. **1.3 Projectile Motion and circular motion [04 Marks]** • Definition of a projectile motion, angle of projection, trajectory, time of flight and range with formulae. • Definition of a circular motion, centripetal acceleration, centripetal force, definition of centrifugal force, and its applications.	**10**	**16**
Topic 2] Nondestructive Testing of materials. **Specific Objectives:** ➢ Describe the method of production of ultrasonic waves ➢ Use NDT methods for quality testing of materials in industry **2.1 Ultrasonic [04 Marks]** • Ultrasonic waves-properties, production of ultrasonic waves by piezoelectric method **2.2 Non –destructive testing methods [06 Marks]** • Destructive and Nondestructive testing, advantages of NDT, limitations of N.D.T., different N.D.T. Methods used in industries, criteria for selection of NDT method, Liquid penetration Testing (LPT): principle, procedure and applications, Ultrasonic testing methods:-principle, procedure and applications.	**06**	**10**
Topic 3] Acoustics and Indoor lighting: **Specific Objectives:** ➢ Find the Conditions for good acoustics ➢ Determine factors affecting acoustical planning of auditorium ➢ Apply Inverse square law of photometry ➢ Find working and applications of Bunsen's photometer **3.1 Acoustics: [06 Marks]** • Echo, reverberation, standard reverberation time, Sabine's formula,	**08**	**12**

conditions for good acoustics, factors affecting acoustical planning of auditorium. **3.2 Indoor lighting: [06 Marks]** • Definition of luminous intensity, intensity of illumination with their SI units, inverse square law of photometry, Bunsen's photometer - ray diagram, working and applications, need of indoor lighting, indoor lighting schemes and factors affecting indoor lighting.		
Topic 4]: Modern physics. **Specific objectives:** ➢ Derive Planck Einstein equation ➢ State the concept of photocell ➢ State applications of X - ray **4.1 Photo electricity: [06 Marks]** • Photon (quantum), Plank**'s** hypothesis, energy of photon**,** properties of photons. • Photo electric effect: Circuit diagram, process of photoelectric emission, definitions:-threshold frequency, threshold wavelength, stopping potential, characteristics of photoelectric effect • Work function, Einstein's photoelectric equation, photo resistor (LDR) – symbol, principle, applications, photoelectric cell:-principle, applications. **4.2 X-rays: [06 Marks]** • Origin of X-rays, production of X-rays using Coolidge's X-ray tube, minimum wavelength of X-ray, properties of X-rays, applications of X- rays: engineering, medical and scientific.	**08**	**12**
TOTAL	**32**	**50**

Practical: Skills to be developed:

Intellectual Skills:

- Proper selection of measuring instruments on the basis of range, least count, precision and accuracy required for measurement.
- Verify the principles, laws, using given instruments under different conditions.
- Read and interpret the graph.
- Interpret the results from observations and calculations.
- Use these results for parallel problems.

Motor Skills:

- Proper handling of instruments.
- Measuring physical quantities accurately.
- Observe the phenomenon and to list the observations in proper tabular form.
- Adopt proper procedure while performing the experiment.

List of Experiments:

Sr No	Title of Experiment	To be performed by a group of
1	Determine the radius of spherical surface using spherometer	2 **Students**
2	Find refractive index of prism by using spectrometer	4 to 5 **students**
3	Calculate coefficient of absorption for acoustical materials	2-3 **students**
4	Compare luminous intensities of two luminous bodies by using Bunsen's photometer	4 to5 **students**
5	Verify characteristics of photoelectric cell.	4 to5 **students**
6	Calculate coefficient of linear expansion of a metal rod using Pullinger's apparatus.	2 to 3 **students**
7	Determine velocity of sound by resonance tube.	4 to5 **students**
8	Determine rigidity modulus of given wire using torsional pendulum.	2 to3 **students**
9	Calculate acceleration due to gravity using compound bar pendulum	4 to5 **students**

Learning resources:

1. **Books:**

Sr. No.	Title	Author	Publisher
01	Engineering Physics	by R.K.Gaur and S.L.Gupta	Dhanpat Rai Publication, New Delhi.
02	Fundamental of Physics	Resnick and Hailday	Wisley Toppan Publishers – England
03	Engineering Physics	V. Rajendran	Tata McGraw-Hill Publications
04	Engineering Physics	K. Rajgopal	PHI learning pvt ltd. New Delhi
05	Physics- Std XI, Std XII	-	HSC board/c CBSE Board
06	Conceptual Physics	P.G.Hewitt	Pearson Education, Tenth edition
07	A text book of engineering Physics	M.N. Avadhanulu P.G. Kshirsagar	S.Chand & co. Ltd

2. Websites:

http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.html
http://physics.info
http://physics.org
http://about.com
http://classroom.com
http://101science.com

3) Videos:

http://www.youtube.com/watch?v=ZmhuCIL5BqQ: work power energy
http://www.youtube.com/watch?v=8kOSth5QgF4: motion in one dimension, rectilinear motion
http://www.youtube.com/watch?v=SsIaL3L6Jg4: projectile motion http://www.cmslaser.com

4) CD:

Educational Cd of NCERT
Educational cd of Pearson education India

5) PPT:

PPT www.dboccio.com/Physics%20PowerPoints/Work,%20Energy,
www.khanacademy.com

5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing

[The methods used to explain the contents are just guideline. Any relevant methods can be used for better understanding of students and effective teaching learning process]

Topic I	**Motion** Name**:** Motion: Facts: Displacement, velocity, acceleration Force, momentum, impulse Projectile, Angle of projection Centripetal acceleration Projectile, Angle of projection Concepts: Rectilinear Motion, Angular Motion, Equations of motion Laws of motion and Kinetics Projectile Motion, time of flight and range Principles: Newton's laws of Motion, Law of Momentum, Work Energy Principle Laws of Motion Reference Material: Books: Title: 1) Fundamental of Physics Resnick and Hailday - Wisley Toppan Publisher 2) Physics- Std XI, Std XII- HSC board/CBSE Board Teaching Aids: • Explanation using live examples. such as motion of a body in straight line, motion of planets, pendulum clock, turbines, motion of wheels, motion of lift • Solving numerical on related situations. PPT with Sample: Websites http://www.youtube.com/watch?v=ZmhuCIL5BqQ: work power energy http://www.youtube.com/watch?v=8kOSth5QgF4: motion in one dimension, rectilinear motion http://www.youtube.com/watch?v=SsIaL3L6Jg4 :projectile motion
Lecture No.	Topic/ Subtopic to be covered
1	**1. 1 Rectilinear and Angular Motion** • Importance of Applied physics in engineering and everyday life, • curriculum, specific objectives teaching schemes, exam schemes , lab manual, • learning structure • Equations of motion:-V=u+at, S=ut+1/2at^2, V^2=u^2+2as (no derivation), distance traveled by particle in n^{nt} second, (only equation), Uniform velocity, uniform acceleration and uniform retardation, equations of motion for motion under gravity. **(** Explanation using live examples. such as motion of a body in straight line)
2	• Solving numerical on related situations on contents learnt in Lecture-1
3	• Definition of angular displacement, angular velocity, angular acceleration, relation between angular velocity and linear velocity, three equations of angular motion (no derivation) angular distance traveled by particle in n^{nt} second (only equation). (Explanation using live examples. such as motion of planets, pendulum clock, turbines, motion of wheels, motion of lift)
4	• Solving numerical on related situations on contents learnt in Lecture-3
5	**1.2 Kinetics and Work Power Energy** • Definitions of momentum, impulse, impulsive force with formulae, statements of Newton's laws of motion with equations, applications of laws of motion—recoil of gun. (Explanation using live examples. such as pendulum clock, motion of gun.)

6	• Solving numerical on related situations on contents learnt in Lecture-5
7	• Definition of work, power and energy, equations for potential energy. kinetic energy, work -energy principle. (Live examples to distinguish between KE and PE such as moving hammer, flying parrot)
8	• Solving numerical on related situations on contents learnt in Lecture-7
9	**1.3 Projectile Motion and circular motion** • Definition of a projectile motion, angle of projection, trajectory, time of flight and range with formulae.(Explanation using live examples. such as motion of planets, projection of satellite • Demo of a trajectory of projectile using flow of water through a tube)
10	• Solving numerical on related situations on contents learnt in Lecture-9
Topic 2	**Nondestructive Testing of materials.** Name: Nondestructive Testing of materials. Facts : Destructive and Non-destructive Testing Concepts: Capillarity, Penetration of Ultrasonic waves. Principle : LPT, UT as probing methods Reference Books : Engg physics – V Rajendran Conceptual Physics- P.G.Hewitt- Pearson Education, Tenth edition Teaching Aids:Demonstration from E scheme lab manual PPT with Sample: Google advance search Websites: http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.html, http://physics.info,
Lecture No.	Topic/ Subtopic to be covered
1	**Nondestructive Testing of materials.** **2.1 Ultrasonic** • Revision of types of wave • Ultrasonic waves-properties, • (Explanation using electromagnetic spectrum, Chart)
2	• Production of ultrasonic waves by piezoelectric method. (Explanation using PPT,Charts)
3	**2.2 Non –destructive testing methods** • Destructive and Nondestructive testing, advantages of NDT, limitations of NDT (Explanation using industrial applications)
4	• Different N.D.T. Methods used in industries, criteria for selection of NDT method (Videos, Expert lecture from industry person)
5	• Liquid penetration Testing (LPT): principle, procedure and applications, (Explanation using demo of LPT kit in physics lab.)
6	• Ultrasonic testing methods:-principle, procedure and application (Explanation using PPT,Charts)
Topic 3	**Acoustics and Indoor lighting:** Name: Acoustics and Indoor lighting Facts: Echo, Reverberation, Luminous Intensity, Illuminance , Luminous flux Concepts: Sound, Acoustics, Relation between Illuminance, luminous intensity, indoor lighting Principles: Sabine's formula of reverberation time, Inverse square law of Illumination Reference Material: Books: Title: 1) Engineering Physics : by R.K.Gaur and S.L.Gupta - Dhanpat Rai Publication, New Delhi Teaching Aids: chart – Refer expt. no.3 and 4 from lab manual ,Videos and PPTs PPTwithSample: Google advance search

	Websites: http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.html, http://physics.info, Educational Cd of NCERT Educational cd of Pearson education India
Lecture No.	• Topic/ Subtopic to be covered
1	**Acoustics:** • Recalling concepts studied such as wave motion, S.H.M. ,sound wave as a longitudinal ,transverse waves, resonance etc.Introduction to characteristics of sound wave. • Echo, reverberation.(explanation using some examples such as Bijapur's Golkonda fort or similar)
2	• standard reverberation time, Sabine's formula, conditions for good acoustics.(explanation using live examples such as acoustical planning of lecture hall)
3	• Solving numerical on related contents learnt in Lecture-2
4	• factors affecting acoustical planning of auditorium. (Explanation by recalling the contents studied in lecture 1,2,3 and expert lecture, audio, video, lab manual expt no. 3 etc.)
5	**Indoor lighting:** • Introduction to light as a energy , characteristics of light • Definition of luminous intensity, intensity of illumination with their SI units
6	• Inverse square law of photometry, Bunsen's photometer - ray diagram, working and applications
7	• Solving numerical on related contents learnt in Lecture-6
8	• Need of indoor lighting, indoor lighting schemes and factors affecting indoor lighting (explanation using some examples such as lighting system for auditorium, hotel, restaurant)
Topic 4	**Modern physics.** Name: Modern physics. Facts: Photocell, Electromagnetic spectrum, Light Amplification Concepts: Photoelectric emission, LASER and its properties Principles: Photoelectric effect, X-rays, Stimulated emission, population inversion Reference Material: Books: Title: 1) Engineering Physics : V Rajendran- Tata McgrawHill publication 2) Engg physics – V Rajendran Teaching Aids: Charts, Experiment number 3 and 4 (E and G scheme lab manual) PPTwithSample: Educational Cd of NCERT Educational cd of Pearson education India Websites : http://www.youtube.com Laser cutter http://www.cmslaser.com
Lecture No.	Topic/ Subtopic to be covered
1	**4.1 Photo electricity:** • Photon (quantum), Plank's hypothesis, energy of photon, properties of photons. (Explanation using PPTs, Videos, Charts)
2	• Photo electric effect: Circuit diagram, process of photoelectric emission, (Refer expt no.4 from lab manual.Demo using Light detector.Examples such as automatic operations of water tap, doors, ACs etc.)
3	• Definitions:-threshold frequency, threshold wavelength, stopping potential, characteristics of photoelectric effect (Explanation using characteristics curve.) Work function, Einstein's photoelectric equation (Chalk-board)

4	• Solving numerical on related contents learnt in Lecture-3
5	• photo resistor (LDR) –symbol, principle, applications, (Refer lab manual, demo)
6	• Photoelectric cell:- principle, applications. (Refer lab manual, demo)
7	**4.2 X-rays:** • Origin of X-rays, production of X-rays using Coolidge's X-ray tube, (Explanation using charts, sample X-ray photograph of a human body.)
8	• Minimum wavelength of X-ray, properties of X-rays, applications of X- rays: engineering, medical and scientific.(Solving numerical on λmin)

5.2 Planning and Conduct of Test:

Sr No	**Class Test**	**Marks**	**Topics**
1	Class Test 1	25	• Motion • Non destructive Testing
2	Class Test 2	25	• Acoustics and Indoor lighting • Modern Physics

5.3 Strategies for Conduct of Practical:

5.3.1 Approach for design of Manual:

- Basic approach of lab manual is to develop better understanding of importance of the subject and to know related skills to be developed such as intellectual skills and motor skills.
- While designing the experiments, activities are added in the experiment so that the contents can be related to applications in the industry.

5.3.2 Suggestions for effective conduct of practical and assessment:

- Display the Datewise schedule of the experiment to be performed in the Laboratory.
- Display the given data of each experiment in the Laboratory.
- Display the charts of all measuring instruments of the concerned experiments with their Least Counts.
- At the beginning of the semester teacher/lab assistant should check and ensure that the equipments used for the experiments are in proper working condition
- Teacher should refer the guidelines given in the lab manual.
- Teacher should make the students aware of instructions given in the lab manual.
- Teacher should motivate the students by taking activities on related contents in theory and practical.
- Teacher should ensure that at least one activity given in the Lab Manual is performed by the student and observations should be tabulated.
- There should be **one revision practical after every three regular practical** so that student can grasp the contents deeply.
- Teacher should make the assessment report of students during the repetition round.
- Teacher should assess the students on the basis of his/her participation in a group during practical (refer 4 point scale in assessment norms of MSBTE)

- Teacher should give marks out of 10 for each practical.
- **Questions on confirmation of learning (given below observation table of every experiment) are compulsory**.

5.3.3 Preparation for conduct of practical

- Experimental set up with sample reading (Expected result) should be available with the concerned teacher before commencement of each experiment.
- Teacher should give the instruction regarding proper handling of instruments, precautions while performing the experiment, taking observations etc.

6 Mode of assessment:

6.1 Class Test Schedule (As per MSBTE):

- It is proposed that 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.
- Teacher should show the answer papers of class test to the students and maintain the records as per MSBTE norms.

6.1.1 Guidelines for Setting Class Test Question Paper:

Question No 1: Attempt any four out of six (2 x 4 =8 Marks)

Question No 2: Attempt any three out of five (3 x 3=9Marks)

Question No 3: Attempt any two out of three (4 x 2 =8Marks)

6.1.2 Sample Test Papers: