CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR BASIC SCIENCE - (CHEMISTRY) (17103)

FIRST SEMESTER

JULY 2012

MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION, Mumbai

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 pass outs. 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.

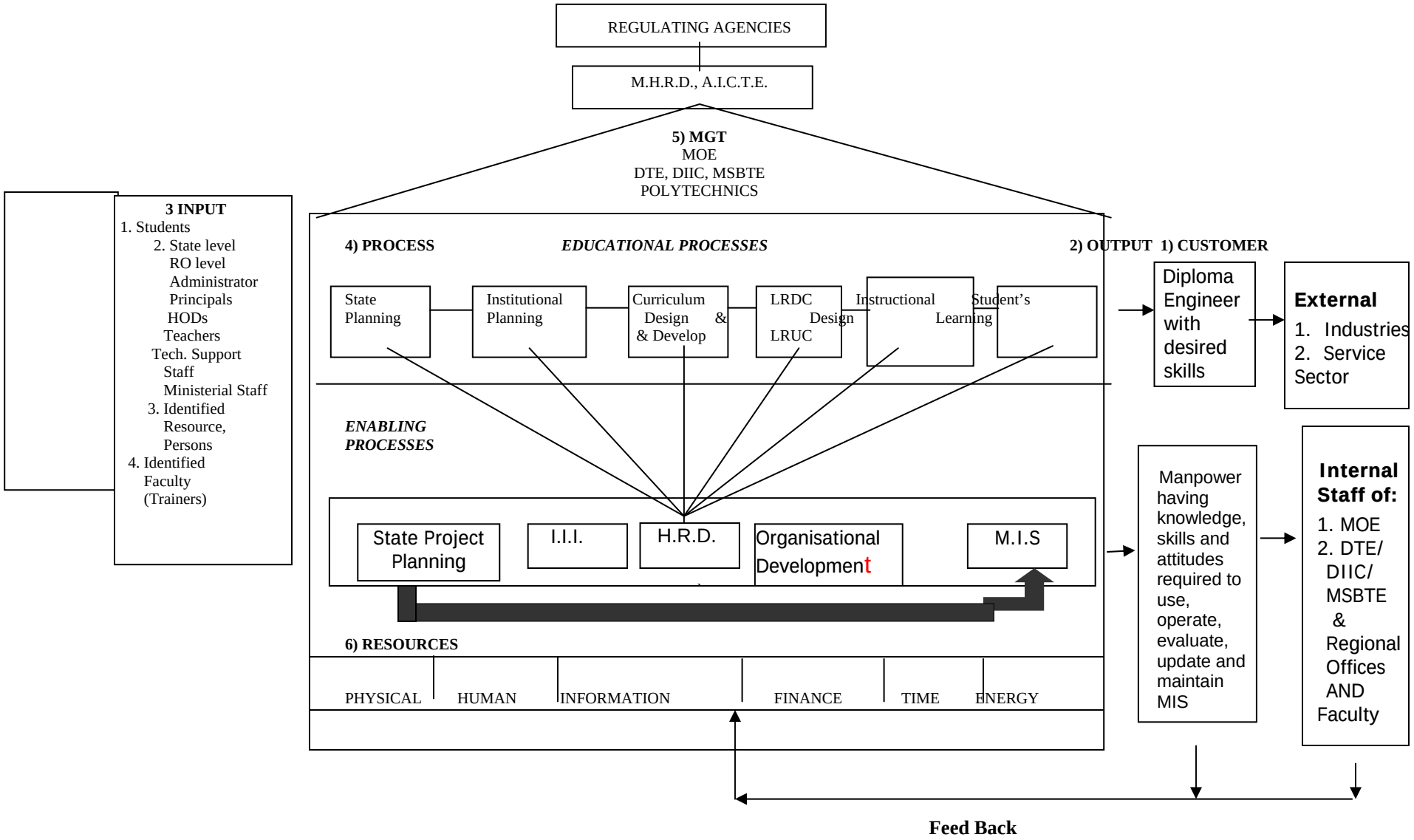


Fig 1 Systems Approach

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:

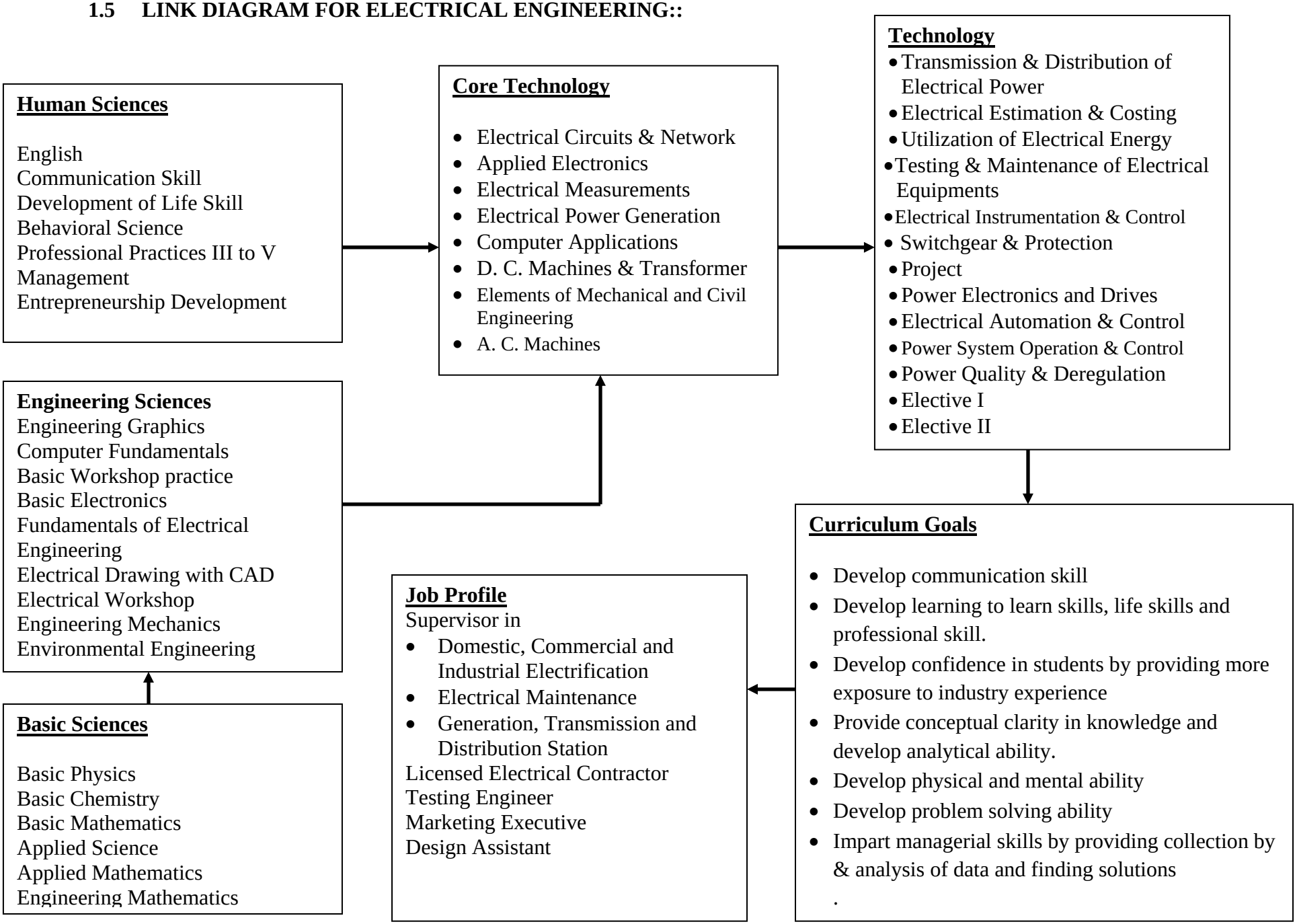
Intellectual Skills:

- 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 DIAGRAM – Stimulus and Response

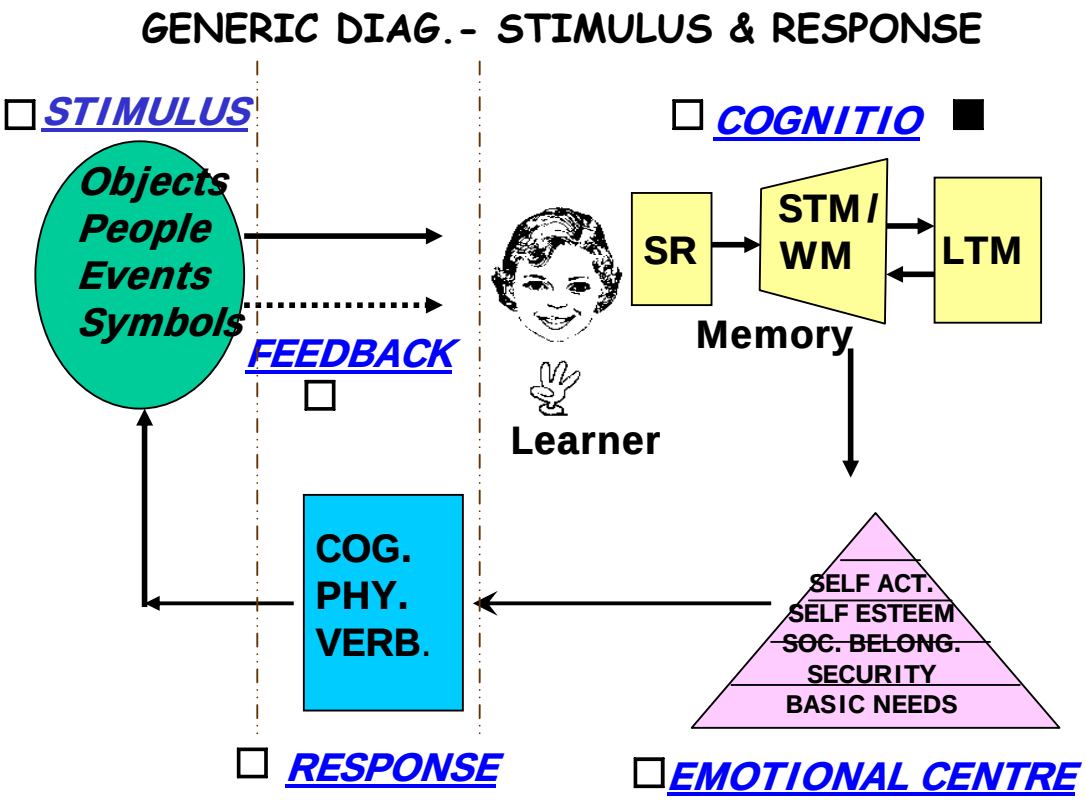


Fig. 2: Generic Diagram of Learners.

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.

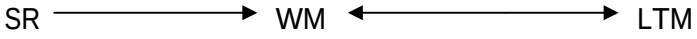
Feedback: When teacher asks the question, you answer it. Then based on the content of the answer, teacher says whether it is 'correct' or 'wrong'. This is feedback. Thus it may be the information about the changed stimulus situation provided after response by the learner. Feedback helps learner to compare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

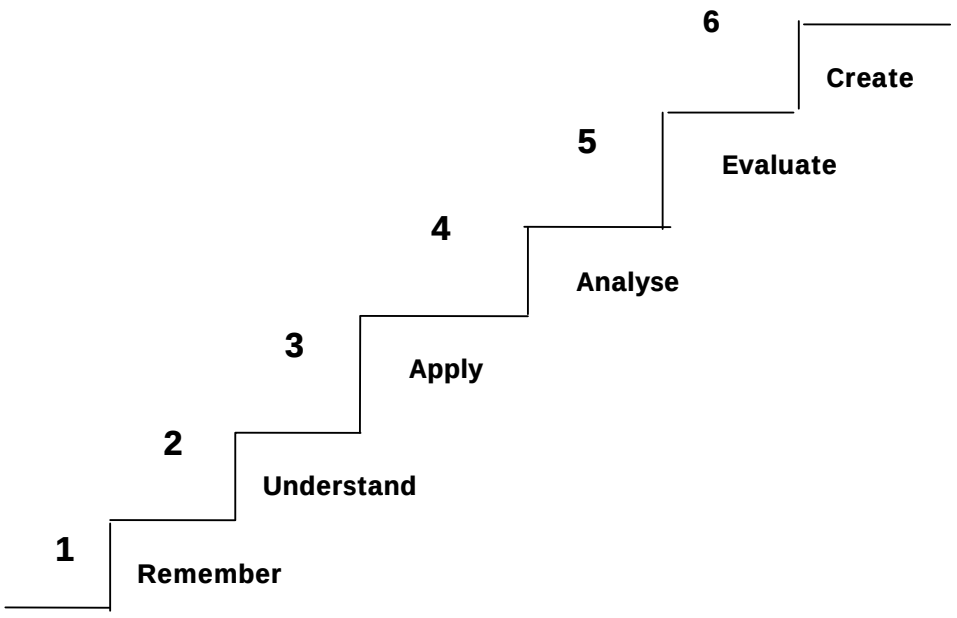
Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for the purpose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

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

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

2.5.3 Learning Structure: It graphically/pictorially indicates the content of the curriculum of the subject and what is to be learnt in the subject. As you know that 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. Therefore 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

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 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 (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 : All Branches of Diploma in Engineering and Technology

Course Code: AE/CE/CH/CM/CO/CR/CS/CW/DE/EE/EP/IF/EJ/EN/ET/EV/X/IC/ IE/IS/ME/MU/PG/PT/PS/CD/CV/ED/EI/FE/IU/MH/MI

Semester : First

Subject Title : Basic Science (Chemistry)

Subject Code : 17103

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).
- Students should compulsorily appear for Basic Science (Physics) & Basic Science (Chemistry) theory examination. There is combined passing for the subject (40/100).
- Students should compulsorily appear for Basic Science (Physics) & Basic Science (Chemistry) practical examination. There is combined passing for the subject (20/50).

Rationale:

Basic Chemistry is the basic science which is essential to all engineering courses. For an engineer, the usage of equipments and instruments would require knowledge of chemical substances, their composition and properties. Hence the content of this subject provides knowledge of engineering materials. This knowledge also aims to bridge the theoretical concepts and their practical engineering applications, thus highlighting the role of chemistry in the field of engineering. It helps in understanding chemical and physical properties of engineering materials.

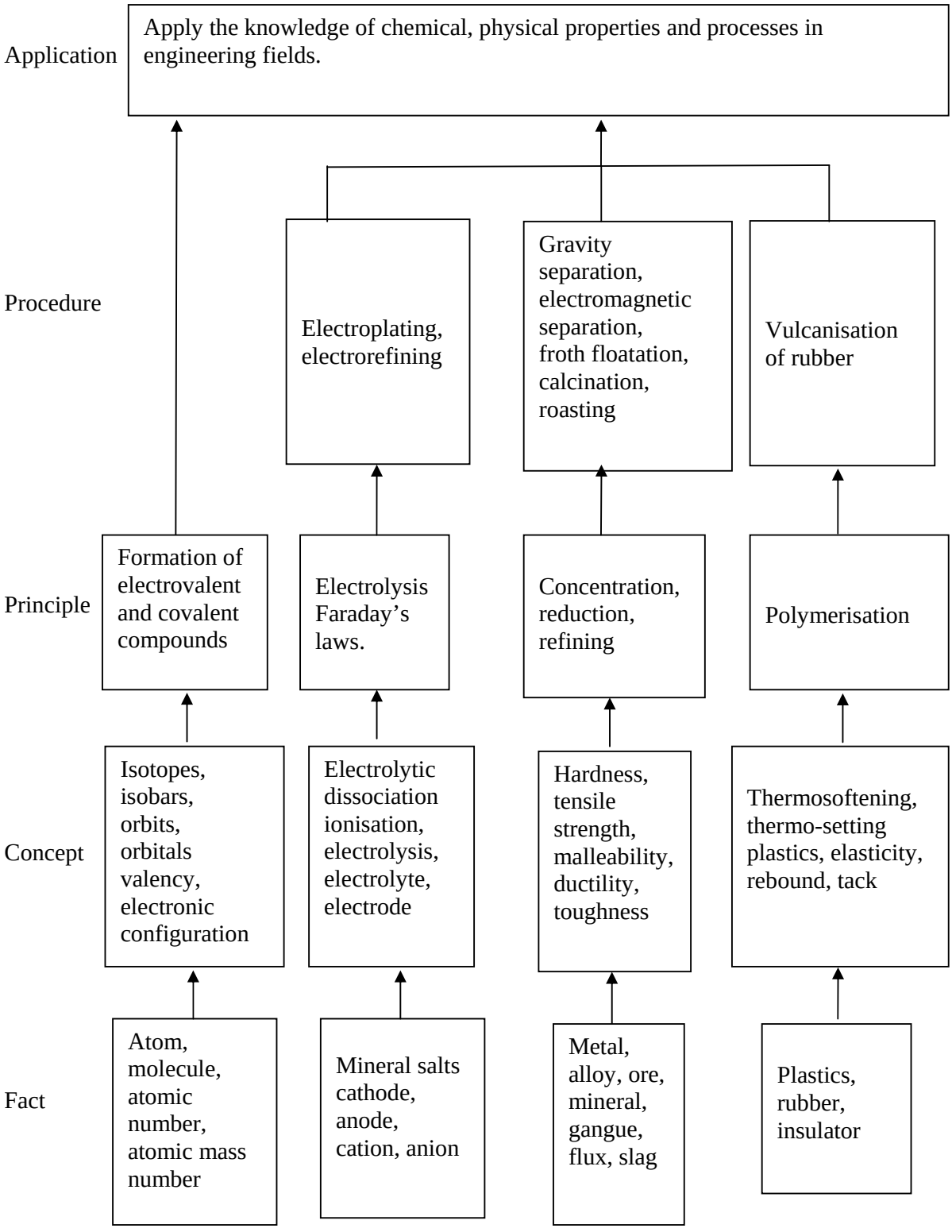
The content of this curriculum has four units which provide the knowledge of chemical bonding, mechanisms of various applications of electrochemistry. It also provides in depth knowledge of extraction processes, properties and applications of metals and alloys. The non-metallic materials like plastics, rubber, insulators are the back bone of developing industries.

General Objectives:

The student will be able to

1. Know the concepts of valence electrons and valency of elements.
2. Apply the knowledge of electrolysis in engineering applications.
3. Understand the formation of various molecules.
4. Apply the properties of metals and alloys in engineering field.
5. Use non-metallic materials in engineering applications.

Learning Structure:



Theory Content:

Topic and Contents	Hours	Marks
Topic 1] Chemical Bonding: **Specific Objectives:** ➢ Predict valence electrons and valency of elements. ➢ Draw schematic diagram for formation of molecules. **1.1 Atomic Structure: [8 Marks]** • Definition of atom, Bohr's atomic model, structure of modern atom, characteristics of fundamental particles of an atom, definition of atomic number, atomic mass number and their differences, Isotopes and Isobars: Definitions, examples and distinction, applications of carbon and cobalt isotopes. Orbits: Bohr's energy levels, sub-energy levels, s, p, d, f orbitals, shapes and description of s-orbital and p- orbital. Distribution of electrons in orbitals: Definition of electronic configuration, Aufbau's principle, Hund's rule, orbital electronic configurations (s, p, d, f) of elements having atomic number 1 to 30, **1.2 Valency: [4 Marks]** • Definitions of valence electrons, valency, Electronic theory of valency. • Definition of electrovalency, positive and negative electrovalency, formation of Electrovalent compounds-MgO,$CaCl_2$ • Definition of covalency, single, double and triple covalent bonds, formation of Covalent compounds H_2O,CO_2,N_2	**08**	**12**
Topic 2] Electrochemistry: **Specific Objectives:** ➢ Describe the mechanism of electrolysis. ➢ Identify the role of electrodes in application of electrolysis. **2.1Basic concepts of electrolysis: [4 Marks]** • Electrolyte, types of electrolyte- strong and weak electrolyte, their difference. • Ionisation and electrolytic dissociation, Arrhenius theory of electrolytic dissociation, degree of ionization, factors affecting degree of ionization. Definitions of electrolytic cell, electrodes-cathode, anode, electrode potential-oxidation potential and reduction potential. **2.2Electrolysis: [10 Marks]** • Mechanism of electrolysis- Electrolysis, electrochemical series for cations and anions, • Mechanism of electrolysis of $CuSO_4$ solution by using platinum electrodes and copper electrodes • Applications of electrolysis- Electroplating of silver, electro refining of blister copper, • Faraday's laws of electrolysis: Faraday's first and second law, relation between electrochemical equivalent and chemical equivalent, Numericals. • **pH and pOH:** Definition of pH, pOH, pH Scale, Numericals.	**10**	**14**
Topic 3] Metals and Alloys: **Specific Objectives:** ➢ Identify the properties of metals and alloys related to engineering applications. ➢ Describe the process of extraction of metals. **3.1 Metals: [8 Marks]** • Occurrence of metals in free and combined state, definitions- mineral, ore,		

gangue, flux and slag, metallurgy. • Metallurgy- Detailed Flow chart for extraction of metal, • Important extraction processes-Concentration-gravity separation, electro-magnetic separation, froth floatation, calcination and roasting, Reduction-smelting in blast furnace, aluminothermic process, Refining- poling, electrorefining • Mechanical properties of metals- Hardness, ductility, malleability, tensile strength, toughness, machinability, weldability, forging, soldering, brazing, castability. **3.2 Alloys: [4 Marks]** • Definition, purposes of making alloys with examples. • Preparation methods- Fusion, Compression. • Classification of Alloys- Ferrous and non ferrous alloys with examples. • Examples of alloys- Composition, properties and applications of duralumin, Woods metal, babbit metal.	**08**	**12**
Topic 4] Non-metallic Engineering Materials: **Specific Objectives:** ➢ Distinguish between thermosoftening and thermosetting plastics. ➢ List the properties of rubber ➢ State the applications of thermal insulators. **4.1 Polymers (Plastics, Rubber) : [8 Marks]** • Plastics: Definition of plastic, polymer, polymerisation, types of polymerization-Addition polymerization, principle, examples- formation of polyethylene and polyvinyl chloride. Condensation polymerization, principle, examples- formation of Bakelite plastic and Nylon 6:6 • Types of plastic- thermo softening plastics and thermosetting plastics and their differences, compounding of plastic, properties and applications of plastics. • Rubber: Types of rubber. • Natural Rubber- definition, drawbacks of natural rubber, vulcanization of rubber with chemical reaction, applications of vulcanized rubber. Synthetic rubber- definition, difference between natural and synthetic rubber, examples of synthetic rubber, properties of synthetic rubber like - elasticity, tack, and abrasion resistance, their definition and related applications. **4.2 Thermal Insulators [4 Marks]** • Thermal Insulators -Definition, characteristics of thermal insulators, classification-organic and inorganic thermal insulators, their examples, preparation, properties and applications of thermocole and glasswool.	**06**	**12**
Total	**32**	**50**

Practical:

Intellectual Skills:

1. Analyze given solution and to find the chemical properties of metallic and non-metallic ions.
2. Interpret the results of experiments or numerical values.
3. Understand the set up of the experiment.
4. Verify the laws and characteristics.

Motor Skills:

1. Handle various laboratory reagents.
2. Accurately measure proper quantity of various chemicals.
3. Observe correct colour of precipitate, evolution of gas.
4. Connect electrical circuit as per the circuit diagram.
5. Proficiently handle apparatus and equipments to perform experiments.
6. Observe the completion of reaction.

List of Experiments:

Sr. No.	Name of the experiment
1	Know your Chemistry laboratory and prepare sample solutions of different concentrations.
2	Determine the basic radical (metallic ion) and acidic radical (non-metallic ion) by qualitative analysis of given salt solution no-1.
3	Determine the basic radical (metallic ion) and acidic radical (non-metallic ion) by qualitative analysis of given salt solution no-2.
4	Determine the basic radical (metallic ion) and acidic radical (non-metallic ion) by qualitative analysis of given salt solution no-3.
5	Determine the basic radical (metallic ion) and acidic radical (non-metallic ion) by qualitative analysis of given salt solution no-4.
6	Determine the basic radical (metallic ion) and acidic radical (non-metallic ion) by qualitative analysis of given salt solution no-5.
7	Calculate the electrochemical equivalent of copper by electrolysis of copper sulphate solution using copper electrodes.
8	Determine pH value of given solutions by using pH paper, universal indicator and pH meter.
9	Prepare Phenol formaldehyde resin used in manufacturing of Bakelite plastic.

Learning Resources:

1. Reference books: Latest Editions

Sr. No.	Author	Name of the book	Publisher
1	Jain and Jain	Engineering Chemistry	Dhanpat Rai and Sons
2	----	Engineering Chemistry	Wiley India Edition
3	B. K. Sharma	Industrial Chemistry	Goel Publication
4	S. S. Dara	Engineering Chemistry	S. Chand Publication
5	NCERT	Chemistry Textbook for ClassXI &XII	NCERT
6	Vedprakash Mehta	Polytechnic Chemistry	Jain Brothers

2. List of web sites/ Videos and animations:

Chemical Bonding
http://en.wikipedia.org/wiki/Electron_configuration
http://www.chemguide.co.uk/atoms/propsmenu.html#top
http://www.chem1.com/acad/webtext/chembond/
http://www.footprints-science.co.uk/Chemistry.htm
http://www.youtube.com/watch?v=8tqfDE6vqcs&feature=related(Ionic Bonding)
http://www.youtube.com/watch?v=KjoQHqgzda8&feature=related(Chemical Bonding)
http://dwb4.unl.edu/chemAnime/ECONFIG/ECONFIG.html(electronic Configuration)
http://employees.oneonta.edu/viningwj/sims/atomic_electron_configurations_s1.html (electronic Configuration)
http://employees.oneonta.edu/viningwj/sims/atomic_electron_configurations_s2.html (electronic Configuration of Ions)
http://www.kentchemistry.com/links/AtomicStructure/PauliHundsRule.htm (Hunds Rule)
http://www.quimica3d.com/animations/en-21a.php (Orbital)
http://www.ausetute.com.au/lewisstr.html (Lewis Structure)
http://winter.group.shef.ac.uk/orbitron/AOs/2p/index.html (Atomic Orbitals)
http://ippex.pppl.gov/interactive/matter/molecule.html
http://www.kentchemistry.com/links/bonding/typesofBonds.htm (Chemical Bond)

Electrochemistry
http://en.wikipedia.org/wiki/Electrolysis
http://www.chem1.com/acad/webtext/elchem/
http://www.splung.com/content/sid/3/page/batteries
www.teachnet-uk.org.uk/...Metals/...metals/Properties%20of%20Meta...
http://www.authorstream.com/Presentation/aSGuest33360-286609-froth-flotation-Entertainment-ppt-powerpoint/
http://dwb4.unl.edu/chemAnime/index.htm
http://physchem.co.za/OB12-che/electrolysis.htm#copper (Electrochemistry)
http://www.mindzeit.com/chemistry.php

Metals and Alloys
http://en.wikipedia.org/wiki/Metal

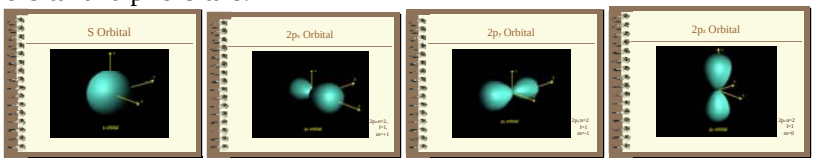
Plastic and Rubber
http://www.tvo.org/iqm/plastic/animations.html# (Addition Polymerization)
http://www.tvo.org/iqm/plastic/animations.html# (Condensation Polymerization)
http://www.chemistryland.com/PolymerPlanet/Polymers/PolymerTutorial.htm (Plastic)
http://www.elmhurst.edu/~chm/vchembook/403rubber.html (Rubber)

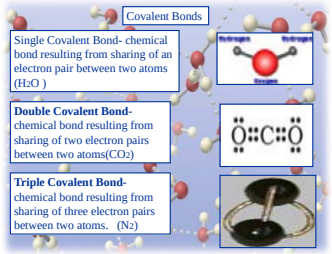
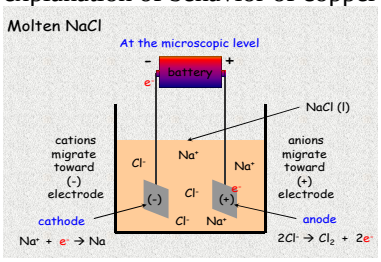
5. IMPLEMENTATION STRATEGY:

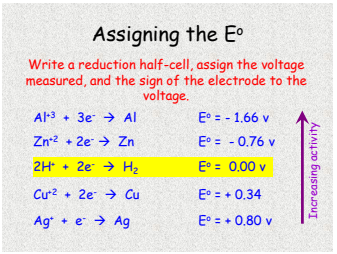
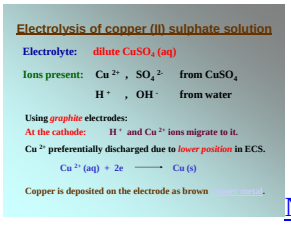
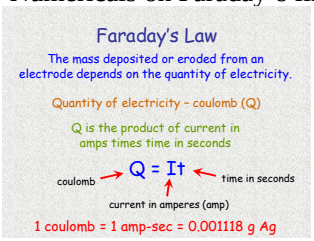
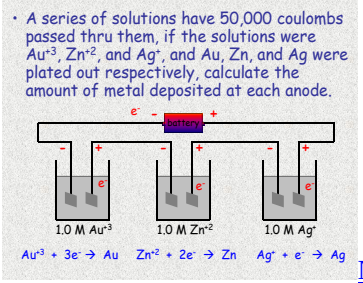
5.1 Planning of Lectures for a Semester with Content Detailing:

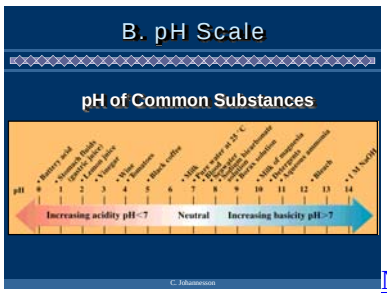
<table>
<tr><td>Topic 1</td><td>Name: Chemical Bonding:

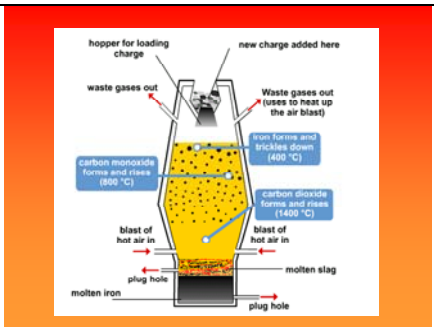
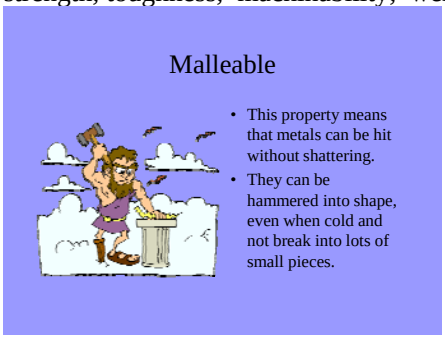
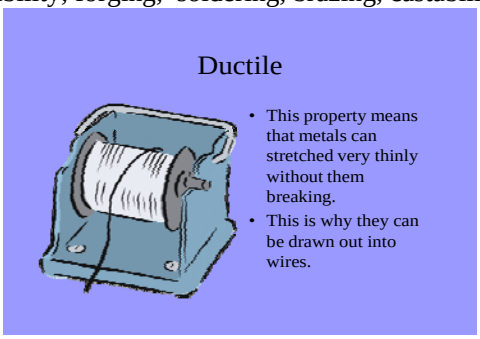
Facts: Atom, molecule, electron, proton, neutron, atomic number, atomic mass number .
Concepts: Isotopes, isobars, orbits, orbital, valency, electronic configuration.
Principles: Formation of electrovalent and covalent compounds, Arrangement of electrons in orbitals.
Reference Material:
Books: Title: 1) A Text Book of Engineering Chemistry, Dr. S. S. Dara, Dr. S. S. Umare, S. Chand, 12th Edition, Page no. 335-339.
2) Text book of XIth and XIIth Chemistry, NCERT.
Teaching Aids: Mendeleev Periodic table, chart of atomic structure, chart of shapes of s, p, d, f-orbitals, chart of formation of compounds, PPTs, LCD projector.
Websites:
PPT with Sample: PPTs can be prepared by using following links on web.
http://www.chemguide.co.uk/atoms/propsmenu.html#top
http://www.chem1.com/acad/webtext/chembond/
http://www.footprints-science.co.uk/Chemistry.htm
http://www.youtube.com/watch?v=8tqfDE6vqcs&feature=related (Ionic Bonding)
http://www.youtube.com/watch?v=KjoQHqgzda8&feature=related(Chemical Bonding)
http://dwb4.unl.edu/chemAnime/ECONFIG/ECONFIG.html(electronic Configuration)
http://employees.oneonta.edu/viningwj/sims/atomic_electron_configurations_s1.html (electronic Configuration)
http://employees.oneonta.edu/viningwj/sims/atomic_electron_configurations_s2.html (electronic Configuration of Ions)</td></tr>
<tr><td>Lecture No.</td><td>Topic/ Subtopic to be covered</td></tr>
<tr><td>1</td><td>• Introduction: Brief discussion about the relevance of Chemistry in industries by giving examples such as type of steel , electroplating & so on.
• Explanation of learning structure.
• Explanation of teaching and examination scheme.
• Brief introduction of all the four units- 1) Chemical Bonding, 2) Electrochemistry, 3)Metals & Alloys, 4) Non Metallic Engineering Materials .
• Explanation of structure of atom, formation of molecule, reactivity of elements based on their properties.
• Electrochemistry and its applications in electroplating and electro refining.
• Metallurgy & applications of alloys in industry based on their properties such as brass, bronze & so on.
• Demand of non-metallic materials such as polymers like plastics, rubber & thermal insulators in engineering applications.</td></tr>
<tr><td>2</td><td>• Definition of atom
• Postulates of Bohr's atomic model
• Structure of modern atom with diagram and description
• Characteristics of fundamental particles of an atom- electron, proton and neutron w.r.t. their symbol, nature, location, mass and charge.
[Teacher shall use the chart of atomic structure or use PPT or video showing structure of atom or use chalk board]</td></tr>
<tr><td>3</td><td>• Definition of atomic number (Z), atomic mass number (A) and any four differences between them. Numericals on A = Z + n.</td></tr>
</table>

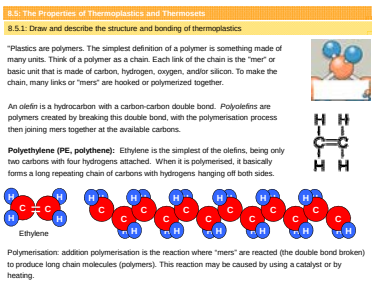
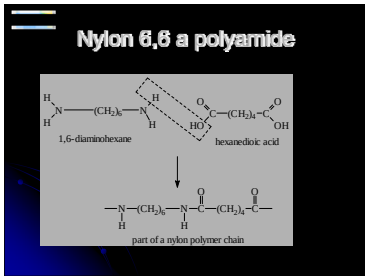
	• Isotopes: Definition, examples of isotopes - H, C, O and Cl with their atomic structures. • Isobars: Definition, Examples of isobars- Ar, K, Ca and Ni and Zn. • Any four differences between isotopes and isobars. • Applications of carbon isotope for radiocarbon dating & medical applications of cobalt isotope . Ref: Engg. Chemistry, Jain & Jain, 15th Edition, page no. 739-741 [Teacher may solve at least three numericals on A=Z+n and give two more for practice.] [Teacher shall use the chart or use PPT or video or use chalk board]
4	• Definition of Orbit. • Definition & labeled diagram of Bhor's energy level . • Definition of sub-energy levels, types of sub-energy levels in K, L, M and N main energy levels. No of electrons in s, p, d and f-subenergy levels. • Definition of orbital, types of orbitals-s, p, d, f orbitals, description of shapes of s-orbital and p- orbitals.  [N:\Teacher Guide\Bonding 2005.ppt] [Teacher shall use the chart or use PPT or video showing s, p, d, f orbitals or use chalk board]
5	• Definition of electronic configuration. • Rules governing distribution of electrons in orbitals as per Aufbau's principle (statement and order of filling of orbitals with few examples) and Hund's rule(statement and examples of C, N and O). http://www.kentchemistry.com/links/AtomicStructure/PauliHundsRule.htm [Teacher shall use chalk board]
6	• Orbital electronic configurations in s, p, d, f of elements having atomic number 1 to 30. Write block diagram as per Hund's rule. [Teacher shall explain with the help of following animation PPThttp://employees.oneonta.edu/viningwj/sims/atomic_electron_configurations_s2.html Or Teacher shall use chalk board]
7	• Definitions of valence electrons giving examples from above electronic configuration. Definition of valency, Electronic theory of valency. Practice of finding out valencies of elements from above examples taken. • Definition of electrovalency, positive electrovalency and negative electrovalency by taking examples of third row elements of periodic table (from Na to Cl) • Formation of Electrovalent compounds-MgO, $CaCl_2$. Schematic representation and description of formation of Electrovalent compounds. • Properties of electrovalent compounds. [Teacher shall use the chart or use PPT or video or use chalk board]
8	• Definition of covalency • Definition of single, double and triple covalent bonds giving examples such as Cl_2,O_2 and N_2 • Formation of Covalent compounds H_2O, CO_2, N_2. Schematic representation and description of formation of covalent compounds • Properties of covalent compounds. • Difference between electrovalent and covalent compounds.

	 PPT: [N:\Teacher Guide\Bonding 2005.ppt] [Teacher shall use the chart or PPT or video or chalk board]
Topic 2	**Name: Electrochemistry** **Facts:** Mineral salts, cathode, anode, cation, anion **Concepts** : Electrolytic dissociation, ionization, electrolysis, electrolyte, electrode. **Principles:** Electrolysis, Faraday's laws. **Reference Material:** Books: Title: 1)Engineering chemistry by Jain & Jain , Dhanpat Rai and Sons, 15th Edition, page no. 231-246. 2) Text book of XIth and XIIth Chemistry, NCERT. Teaching Aids: Chart of electrochemical series, Set up of Daniel cell, videos, power point presentation, reference books, transperencies. Websites: PPT with Sample: http://www.chem1.com/acad/webtext/elchem/ http://physchem.co.za/OB12-che/electrolysis.htm#copper (Electrochemistry) http://www.mindzeit.com/chemistry.php
Lecture No.	Topic/ Subtopic to be covered
1	• Explanation of Basic concepts of electrolysis by giving example of electrovalent compounds such as NaCl & so on. • Definition of electrolyte. • Types of electrolytes-strong and weak electrolyte giving examples of acids HCl, H_2SO_4, HNO_3 and CH_3COOH, H_2CO_3 and examples of bases NaOH, KOH and NH_4OH, $Ca(OH)_2$ • Difference between strong and weak electrolytes. • Definition & differentiation of Ionization and electrolytic dissociation. • Assumptions of Arrhenius theory of electrolytic dissociation. [Teacher shall use chalk board]
2	• Definition and formula of degree of ionization. • Description of factors affecting degree of ionization such as nature of solute, nature of solvent, concentration and temperature. [Teacher shall use chalk board]
3	• Definitions and diagram of electrolytic cell. • Explanation of terms involved in electrolysis such as electrodes-cathode, anode • Description of electrode potential-oxidation potential and reduction potential with explanation of behavior of copper and zinc electrodes in their salt solutions  N:\Teacher Guide\Electrochemistry1.ppt [Teacher shall use the chart or PPT or video or chalk board]

4	• Definition of electrolysis. • Explanation of general mechanism of electrolysis with the help of labeled diagram. • Electrochemical series for cations and anions.  N:\Teacher Guide\Electrochemistry1.ppt [Teacher shall use the chart or PPT or video or chalk board]
5	• Mechanism of electrolysis of $CuSO_4$ solution by using platinum electrodes and copper electrodes.  N:\Teacher Guide\Electrochemistry2.ppt [Teacher shall use the chart or PPT or video or chalk board]
6	• Applications of electrolysis- Electroplating of silver, electro refining of blister copper, [If possible teacher shall give demonstration of electroplating of copper on iron nail.] [Teacher shall use the chart or PPT or video or chalk board]
7	• Statement of Faraday's first law. • Mathematical derivation and formula of Faraday's First Law • Definition of E. C. E. • Relation between electrochemical equivalent and chemical equivalent • Numericals on Faraday's first law.  N:\Teacher Guide\Electrochemistry1.ppt [Teacher shall take the experiment on determination ECE of Cu in the same week during practicals and also show how this law is verified with different time and current] [Teacher shall use the chart or PPT or video or chalk board]
8	• Statement of Faraday's Second law. • Mathematical derivation and formula of Faraday's First Law • Numericals on Faraday's second law.  N:\Teacher Guide\Electrochemistry1.ppt [Teacher shall use the chart or PPT or video or chalk board]

9	• Definition and formula of pH. • Definition and formula of pOH • Diagram and description of pH scale to explain nature of solution. • Numericals on pH and pOH.  N:\Teacher Guide\ph.ppt [Teacher shall take the experiment on determination pH in the same week during practicals] [Teacher shall use the chart or PPT or video or chalk board]
10	Revision on electrolysis mechanism, numerical on Faraday's laws & pH.
Topic 3	**Name: Metals and Alloys:** **Facts:** Metal, alloy, ore, mineral, gangue, flux, slag. **Concepts**: Hardness, tensile strength, malleability, ductility, toughness . **Principles &processes:** Concentration, reduction, refining, Gravity separation, electromagnetic separation, froth floatation, calcination, roasting **Reference Material:** Books: Title**:** 1) Engineering Chemistry by Jain & Jain , Dhanpat Rai and Sons, 15th Edition, pages 1019-1024, 1047-1050. 2) Industrial Chemistry, B.K.Sharma ,Fifteenth Edition,2006,Pages-1609-1620,1666-1678,1687-88 Teaching Aids: Transparencies, , models, Videos, power point presentation, Alloy sample such as fuse wire, pressure cooker valve, duralumin plate. , Websites: http://en.wikipedia.org/wiki/Metal
Lecture No.	Topic/ Subtopic to be covered
1	• Occurrence of metals in free and combined state, Oxides, Sulphides, Carbonates and Hydroxides of iron, calcium, copper ,zinc ore with chemical formula. • Definitions- metallurgy, mineral, ore, gangue, flux and slag. • Difference between mineral and ore . • Detailed Flow chart for extraction of metal- Only mention names of all processes. [Teacher shall use the chart or PPT or video or chalk board]
2	• Principle, Process, Diagram ,Types and example of ore for physical processes of Concentration-gravity separation, electro-magnetic separation, froth floatation process. [Teacher shall use following animation of Froth Floatation, Teacher Guide\YouTube - Froth Floatation Process or chalk board]
3	• Principle, Process, Diagram, Types and example of ore for chemical processes of Concentration- calcination and roasting, Distinguish between calcination and roasting. [Teacher shall use the chart or PPT or video or chalk board]
4	• Description of process of smelting in Blast furnace. • Diagram of Blast furnace, Ingredient added to the blast furnace such as Haematite- ore, carbon-reducing agent, limestone – flux.

	 Teacher Guide\blast furnace.ppt • Reaction of Haematite ore with carbon • Reaction of lime and silica impurity to form calcium silicate slag • Diagram, process and Chemical reaction of aluminothermic process. [Teacher shall use the chart or above PPT or video or chalk board]
5	• Refining- poling - Diagram, process, example of ore • Electrorefining of Copper- Diagram, process, example of ore and reaction. • Mechanical properties of metals- definitions of hardness, ductility, malleability, tensile strength, toughness, machinability, weldability, forging, soldering, brazing, castability.   N:\Teacher Guide\Properties of Metals.ppt [Teacher shall use the chart or above PPT or video or chalk board]
6	• Definition, purposes of making alloys with examples. • Classification of Alloys- Ferrous and non ferrous alloys with examples. • Preparation of alloy by fusion method - diagram, process. Example of preparation of brass and bronze
7	• Preparation of alloy by compression method - diagram, process. Example of preparation of solder alloy and woods metal . • Composition, properties and applications of duralumin, Woods metal, Babbit metal.
8	Revision
Topic 4	**Name: Non-Metallic Materials** **Facts:** Plastics, Rubber, Insulators **Concepts** : Thermo softening plastics, Thermosetting plastics, Elasticity, Tack, Abrasion resistance **Principles:** Polymerization, vulcanization **Reference Material:** Books: Title**:** 1) Engineering chemistry by Jain & Jain , Dhanpat Rai and Sons, 15th Edition, pages119-186. 2) Industrial Chemistry, B.K.Sharma, 15th Edition, 2006, Pages-1609- 620. Teaching Aids: Transperencies, , models, Videos, power point presentation,

	Sample of thermocol and glass wool, PPT with Sample: Websites: http://en.wikipedia.org/wiki/Metal
Lecture No.	Topic/ Subtopic to be covered
1	• Definition of plastic, polymer and polymerization. • Types of polymerization – Addition polymerization with example of polythene and polyvinyl chloride formation with chemical reaction. • Condensation polymerization with examples of Bakelite and nylon 6:6 formation with chemical reaction.  8.5: The Properties of Thermoplastics and Thermosets 8.5.1: Draw and describe the structure and bonding of thermoplastics "Plastics are polymers. The simplest definition of a polymer is something made of many units. Think of a polymer as a chain. Each link of the chain is the "mer" or basic unit that is made of carbon, hydrogen, oxygen, and/or silicon. To make the chain, many links or "mers" are hooked or polymerized together. An *olefin* is a hydrocarbon with a carbon-carbon double bond. *Polyolefins* are polymers created by breaking this double bond, with the polymerisation process then joining mers together at the available carbons. **Polyethylene (PE, polythene):** Ethylene is the simplest of the olefins, being only two carbons with four hydrogens attached. When it is polymerised, it basically forms a long repeating chain of carbons with hydrogens hanging off both sides. Ethylene Polymerisation: addition polymerisation is the reaction where "mers" are reacted (the double bond broken) to produce long chain molecules (polymers). This reaction may be caused by using a catalyst or by heating.  Ref: PPT Plastic 1 Teacher Guide\Plastic 1.ppt Teacher Guide\Polymers_1.ppt http://www.tvo.org/iqm/plastic/animations.html# [Teacher shall take the experiment of formation of Phenol formaldehyde resin in the same week during practicals. Teacher shall use the chart or above PPT or video or chalk board]
2	• Types of plastic- thermo softening plastics and thermosetting plastics and their differences. • Compounding of plastic. • Properties and applications of plastics. [Teacher shall use the chart or PPT or video or chalk board]
3	• Rubber: Types of rubber (natural & synthetic) • Natural Rubber- definition, • Drawbacks of natural rubber, • Vulcanization of rubber with chemical reaction, • Applications of vulcanized rubber. [Teacher shall use the chart or PPT or video or chalk board]
4	• Synthetic rubber- definition, • Difference between natural and synthetic rubber, examples of synthetic rubber, • Properties of synthetic rubber like - elasticity, tack, and abrasion resistance, their definition and related applications. [Teacher shall use the chart or PPT or video or chalk board]
5	• Thermal Insulators -Definition, characteristics of thermal insulators, • Classification- organic and inorganic thermal insulators, their examples, • Preparation, properties and applications of thermocole and glass wool. [Teacher shall use the chart or video or chalk board]
6	Revision

5.2 Planning and Conduct of Test: (As per MSBTE Schedule)

- There will be Two Class Test, each of **25 Marks**.
- Schedule of Class Test and portion shall be declared in advance

Test	Topic	Marks with Option
Class Test 1	Chemical Bonding	**20**
	Electrochemistry	**19**
Class Test 2	Metal and Alloys	**20**
	Non-metallic Engineering Materials	**19**

- Teacher shall also plan test of 10 to 15 marks on limited content in the classroom.

5.3 Details about conduct of assignments:

- Teacher shall give some questions on the topic taught in the lecture as an assignment.
- Assessment of the assignment shall be done during practical hours.
- Regular assessment shall be done on the basis of presentation & timely submission, to motivate the students.

5.4 Strategies for Conduct of Practical:

5.4.1 Approach for design of Manual:

- The experiments shall help students to develop their intellectual and motor skills.
- The new concepts shall be in accordance to the prior concepts and should be related to content of the curriculum.

5.4.2 Suggestions for effective conduct of practical and assessment:

- Teacher shall make the students familiar with the chemistry laboratory through "Know your chemistry laboratory."
- Qualitative analysis has to be given individually. Give first two solutions in common & different solutions from salt solution number 3.
- Make a group of four students each to calculate E.C.E of Cu (Expt No. 7) & in preparation of Phenol formaldehyde resin (Expt No. 9).
- Determination of pH value of solutions(Expt No. 8) shall be given individually.
- Teacher shall explain the stepwise calculation for better understanding of the students.
- At the end of the experiment, teacher shall assign different questions to each student.

5.4.3 Preparation for conduct of practical

- Before commencement of the practical Equipments, chemicals, glass apparatus, required for experiments shall be kept ready.
- Regular maintenance of equipment shall be done.
- Safety chart must be displayed in the laboratory.
- Teacher shall schedule the practical in advance & give prior intimation to the students.
- Student shall be instructed to go through the experiment in advance.
- The weekly continuous assessment shall be done.

6. Mode of assessment:

6.1 Class Test: It is proposed that there will be two tests each of 25 Marks. The tests will be conducted as per the MSBTE Schedule.

- Schedule of Class Test & portion shall be declared in advance

Test Schedule	Topic	Marks with Option
Class Test 1 (25 to 28 Sep2012)	Chemical Bonding	**20**
	Electrochemistry	**19**
Class Test 2 (5 to 10 Nov 2012)	Metal and Alloy	**20**
	Non-metallic Materials	**19**

- Model answers shall be prepared before assessment of answer papers & displayed on notice board / given to the students.
- Teacher shall give feedback to the students about their performance in the test.

6.1.1Guidelines for Setting Class Test Question Paper:

- Q. No1: Attempt any four out of six(each question carries two marks) [Total Marks : 8]
  Q. No2: Attempt any three out of five (each question carries three marks)[Total Marks: 9]
  Q. No3: Attempt any two out of three (each question carries four marks) [Total Marks : 8]

- Question paper should contain 40% question on remember level.
  Question paper should contain 40% question on understand level.
  Question paper should contain 20% question on application level.