LEARNING – TEACHING GUIDELINES FOR STUDENTS AND TEACHERS

This set of instructional objectives has been compiled to show the level of achievement that is expected of an average pupil on completing the study of specific parts of the syllabus. It aims at assisting the teachers in their selection of course materials, learning activities and instructional methods. It can serve as the learning guidelines for the pupils and the basis of an evaluation program.

In stating the specific objectives there are two groups of terms having very similar meaning. The first group is on achievement in recalling facts, which include 'define', describe', and state. **Define** refers to a rather formal definition of terms which involves their fundamental concept. **'Describe'** refers to the recall of phenomena or processes, **'State'** is used when the objective requires the recall of only some aspects of a phenomenon or a process; it limits the scope of teaching.

The second group is on achievement relating to science experiments. This group includes **'design'**, **'perform'**, **'demonstrate'**. **'Design' an experiment** would be used when there are more than one acceptable ways of doing it. Pupils are expected to be able to set up the experiment by applying what they have previously learned. These experiments may require the taking of quantitative data or long term observation. **'Perform' an experiment,** would be used when the objective emphasizes on the demonstration of experimental skill; the detail of the experiment could be found in the teachers' notes or textbooks. **'Demonstrate' a phenomenon** by simple experiments is used when the objective emphasizes on the result of the experiment and the experimental skill involved is very simple, such as passing some gas into a solution **'Describe' an experiment** is used when pupils are expected to know, in principle, how the experiment could be carried out and the expected result.

The Basic Concepts

1. The students will recall the difference between an atom, molecule, ion and molecular ion
2. The students will learn
   i. The scales of relative atomic masses of element
   ii. The determination of relative atomic masses by mass spectrometry and its use to solve the chemical problem.

iii. The concept of mole, Avogadro's number, molar volume and to apply these concept for stoichiometric calculation
iv. The concept of limiting reactant
v. To calculate theoretical and percentage yields using balanced chemical equations.

S-Block Elements

The students will learn

i. To write the electronic configuration of s-block elements in sequence
ii. The occurrence of 1^{st} and 2^{nd} group elements and the peculiar behaviour of lithium and beryllium
iii. The difference in the physical properties of 1^{st} and 2^{nd} group elements as well as the difference in the chemical behavior of their compounds
iv. The commercial preparation of sodium hydroxide
v. The role of gypsum and lime in agriculture and industry

Groups III and IV Elements

The students will learn

i. The names, electronic configuration and occurrence of 3^{rd} & 4^{th} group elements
ii. The peculiar behaviour of boron and carbon in their respective groups
iii. The preparation and properties of Boric acid and orthoboric acid
iv. The reactions of aluminium
v. Structure and properties of oxides of carbon and silicone, silicates, silicones and their uses
vi. The uses of silicon and Germanium in semiconductor industries and lead in paints.

Group V and VI Elements

The students will learn

i. The name and the electronic configuration of 5^{th} and 6^{th} group elements
ii. The properties of oxides and oxyacids of nitrogen and phosphorus halides
iii. To compare the properties oxides and oxygen and sulphur
iv. The manufacture, properties and uses of sulphuric acid.

The Halogens and Noble Gases

The students will learn

i. Names, electronic configuration and the occurrence of halogens, the peculiar behaviour of Fluorine and inertness of noble gases
ii. The volatility of halides and its explanation in terms of vander Wall's forces
iii. The relatives reactivities of halogens as oxidizing agents
iv. The properties of hydrogen halides, oxides and oxyacids of halogens
v. The comparison of thermal stability of hydrides in terms of bond energies
vi. Reaction of chlorine with sodium hydroxide (hot/cold), bleaching powder
vii. The preparation and reactions of bleaching powder
viii. The commercial uses of halogen and their compounds as bleaches, refrigerants and aerosols
ix. The properties of oxides, fluorides and oxy-fluorides of xenon.

The Transition Elements

The students will learn

i. The definition and classification of transition elements
ii. The electronic configuration and the general characteristics like colour, magnetic and catalytic properties of the transition elements
iii. The brief description of manufacture of wrought iron and steel from iron ore
iv. How corrosion is caused and ways to prevent it
v. The important methods of preparation of potassium chromate, potassium dichromate and potassium permanganate and their important properties
vi. The definition of complex compounds and the related terms like ligand, coordination number etc.
vii. The nomenclature and the geometrical shapes of simple complex compounds

Fundamental Principles of Organic Chemistry

The students will learn

i. The special features of carbon chemistry with reference to its ability to form chains, rings and isomers
ii. The importance of organic chemistry in daily life
iii. About the sources of carbon and its compounds like coal, petroleum and natural gas with reference to their availability in Pakistan
iv. Refining, reforming and cracking of petroleum and products in tabulated from
v. How petroleum can serve as a source of different type of fuels

vi. About the classification of organic compounds based on the carbon skeletons
vii. About functional group the dependence of chemical properties on functional groups
viii. About the structural isomerism in organic compounds
ix. That cis-trans isomerism arises due to restricted rotation around a carbon double bond.
x. How the hybridization theory can help us to understand the different types of bounding in organic compounds and their shapes

Aliphatic Hydrogen

The students will learn

i. To name the aliphatic hydrocarbons according to IUPAC rules
ii. The synthesis of alkanes, alkenes and alkynes and their important reactions
iii. The comparison of reactivity of σ bond and π bond
iv. About the free radical nature of reactions of alkanes and electrophilic addition in alkenes and alkynes
v. The comparison of reactivities of alkanes, alkenes and alkynes.

Aromatic Hydrocarbon

The students will learn

i. How to name simple aromatic hydrocarbons
ii. The kekule and resonance approaches to explain the structure and stability of benzene
iii. About the preparation of benzene
iv. About the electrophilic substitution, oxidation and addition reactions of benzene
v. About the isomerism which arises when a second substituent enters the rings
vi. About the comparison of reactivities of Alkanes, Alkenes and Benzene
vii. How does the presence of group alter the reactivity of benzene ring for an electrophilic substitution reaction

Alkyl Halides

The students will learn

i. How to name an alkyl halide and to classify it into primary, secondary and tertiary alkyl halides
ii. Simple ways of generating alkyl halides
iii. The reason why C-X bond in chemistry is one of the most reactive type
iv. The general mechanistic detail of nucleophilic substitution reactions and elimination reactions

v. The preparation of Grignard's reagent, the reactivity of C-Mg bond and its synthetic applications in organic chemistry.

Alcohols, Phenols and Ethers

The students will learn

i. How to name simple monohydric and polyhydric alcohols and their classification as primary, secondary and tertiary alcohols
ii. The importance of synthetic reactions leading to alcohols and industrial process for the commercial manufacture of methanol and ethanol
iii. The nature of OH group and its reactivity when O-H bond is broken and when C-O bond is broken
iv. To distinguish chemically between the primary, secondary and tertiary alcohols
v. The concept of phenols and to understand their acidic nature and two methods for their preparation
vi. The importance of Phenols as starting material for the preparation of five industrially important compounds
vii. How to name ethers and preparation of diethyl ether (two methods)
viii. The physical and chemical behaviour of diethyl ether and its inertness towards chemical reagents

Aldehydes and Ketons

The students will learn

i. How to name aldehydess and ketones up to four carbon atoms
ii. General methods for the preparation of aldehydes and ketones
iii. How are formaldehydes and acetaldehydes commercially prepared
iv. The relationship between structure and reactivity of carboxylic group
v. The reactions of aldehydes and ketones with mechanism
vi. How to identify aldehydes and ketones
vii. The tests for distinction between aldehydes and ketones

Carboxylic Acids and their Derivatives

The students will learn

i. How to name carboxylic acids and their derivatives
ii. The commercial method for the preparation of acetic acid
iii. The relationship between the structure of carboxyl group and its reactivity

iv. The effect of hydrogen bonding on the physical properties of carboxylic acids
v. The ways of preparing four derivatives of carboxylic acids and the conversion of these derivatives back to carboxylic acids
vi. Chemical reactions of carboxylic acid with mechanism
vii. About amino acids and their significance

Macro Molecules

The student will learn

i. The concept of polymerization and macromolecules
ii. Types of polymerization and product of these polymerization e.g. polyvinyl chloride, polystyrene, polyvinyl acetate, poly amids, polyester and epoxy resins
iii. About life molecules as carbohydrates, lipids, protein, enzymes and nucleic acids

Chemical Industries

The students will learn a brief survey of the process along with flow sheet diagram and the reaction involved in the important industries like Fertilizers, Cement and paper

Environmental Chemistry

The students will learn

i. The meaning of environmental pollution
ii. The sources of air pollution like CO, SO_2 and oxides of nitrogen etc
iii. Effects of polluted air on environment
iv. The causes of water pollution
v. The preparation of potable water
vi. About the solids waste and its management like dumping and incineration, treatment of industrial waste and recycling of solids waste.

ASSESSMENT AND EVALUATION

Assessment, appraisal, or evaluation is a means of determining how far the objectives of the curriculum have been realized. What really matters is the methodology employed for such determination. As is now recognized, performance on the basis of content-oriented tests alone does not provide an adequate measure of a student's knowledge and ability to use information in a purposeful or meaningful way; the implication, then, is that effective and rewarding techniques should be developed for evaluating the kind and content of teaching and learning that is taking place and for bringing about improvement in both. The following points, while developing the tests/questions may be kept in view:

1. Proper care should be taken to prepare the objective-type and constructed-response questions relating to knowledge, comprehension, application, analysis and synthesis, keeping in view the specific instructional objectives of the syllabus and the command words for the questions.

2. There should be at least two periodic/monthly tests in addition to routine class/tests. Teachers are expected to develop and employ assessment strategies which are dynamic in approach and diverse in design. When used in combination, they should properly accommodate every aspect of a student's learning.

3. In addition to the final public examination, two internal examinations should be arranged during the academic year for each class.

4. Classroom examinations offer the best and most reliable evaluation of how well students have mastered certain information and achieved the course objectives. Teachers should adopt innovative teaching and assessment methodologies to prepare the students for the revised pattern of examination. The model papers, instructional objectives, definitions of cognitive levels and command words and other guidelines included in this book must be kept in view during teaching and designing the test items for internal examination.

DEFINITION OF COGNITIVE LEVELS

Knowledge:

This requires knowing and remembering facts and figures, vocabulary and contexts, and the ability to recall key ideas, concepts, trends, sequences, categories, etc. It can be taught and evaluated through questions based on: who, when, where, what, list, define, describe, identify, label, tabulate, quote, name, state, etc.

Understanding:

This requires understanding information, grasping meaning, interpreting facts, comparing, contrasting, grouping, inferring causes/reasons, seeing patterns, organizing parts, making links, summarizing, solving, identifying motives, finding evidence, etc. It can be taught and evaluated through questions based on: why how, show, demonstrate, paraphrase, interpret, summarize, explain, prove, identify the main idea/theme, predict, compare, differentiate, discuss, chart the course/direction, report, solve, etc.

Application:

This requires using information or concepts in new situations, solving problems, organizing information and ideas, using old ideas to create new one and generalizing from given facts, analyzing relationships, relating knowledge from several areas, drawing conclusions, evaluating worth, etc. It can be taught and evaluated through questions based on: distinguish, analyze, show relationship, propose an alternative, prioritize, give reasons for, categorize, illustrate, corroborate, compare and contrast, create, design, formulate, integrate, rearrange, reconstruct/recreate, reorganize, predict consequences etc.

DEFINITION OF COMMAND WORDS

The purpose of command words given below is to direct the attention of the teachers as well as students to the specific tasks that students are expected to undertake in the course of their subject studies. Same command words will be used in the examination questions to assess the competence of the candidates through their responses. The definitions of command words have also been given to facilitate the teachers in planning their lessons and classroom assessments.

Calculate:	Is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
Classify:	State the basis for categorization of a set of related entities and assign examples to categories.
Compare:	List the main characteristics of two entities clearly identifying their similarities and differences.
Define the term or terms:	Only a formal statement or equivalent paraphrase is required No examples need to be given.
Demonstrate:	Implies that the candidate is expected to show how is one thing related to another, usually it is a reference to theory but sometimes it is by physical manipulation or experiment.
Describe:	To state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to visual observations associated with the phenomena.
Determine:	Often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula, for e.g. relative molecular mass.
Differentiate:	To identify those characteristics which always or sometimes distinguish between two categories.
Discuss:	To give a critical account of the points involved in the topic.
Draw/Construct:	Implies a simple freehand sketch or diagram. Care should be taken with proportions and the clear labeling of parts.
Explain:	May imply reasoning or some reference to theory, depending on the context.

Find:	A general term that may variously be interpreted as calculate, measure, determine etc.
List/Enlist:	Requires a number of points, generally each of one word, with no elaboration. Where a given number of points are specified, this should not be exceeded.
Outline:	Implies brevity, i.e. restricting the answer to giving essentials.
Predict or Deduce:	Implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.
Prepare:	Implies a practical activity in which the choice of equipment, order of procedure and accuracy of measurement will play a part.
Purify:	Implies a practical activity in which the candidate is expected to apply an approved methodology with appropriate safety precautious.
Relate:	Describe how things depend upon, follow from or are part of another.
State:	Implies a concise answer with little or no supporting argument, for example a numerical answer that can be obtained by inspection.
Identify:	Describe with specific examples of how a given term or concept is applied in daily life.
Explore:	to examine thoroughly and systematically to be able to make a statement about a phenomenon or concept.
Recognize:	involves looking at a given example and stating what it most probably is.
Measure:	To determine extent, quantity, amount or degree of something as determined by measurement or calculation.
Write:	To construct full sentences of continuous prose, not abbreviated text.
Narrate:	To write down the facts and explanation as given or provided in the text.
Show:	Demonstrate with evidence.
Recall:	To bring back to mind and write down, as it is given in the text that you have already memorized.