UNIVERSITY OF PUNE

Circular No. 229 of 1996

In pursuance of the decision taken by the University authorities, it is hereby notified for the information of all concerned that the revised syllabus for F.Y.B.Sc. Chemistry is as given in Appendix 'A'.

This revised syllabus will be implemented from the Academic year 1996-97.

The Principals of all affiliated Colleges in Science where Chemistry is taught , are requested to bring the contents of this circular to the notice of all concerned teachers and students.

Ganeshkhind,
Pune-411 007
Ref.No.CB/533
Date : 12/6/96

for Registrar

Copy f.w.cs. to for information :

1) The Dean of all faculties
2) The Principals of all affiliated college in Science
3) The members of the Boards of Studies in Chemistry
4) The Dy.Registrar, Admission
5) The Asstt.Registrar (Admission)
6) The Section Officer (External)
7) The Section Officer (Affiliation)
8) The Section Officer (Recognition)
9) The Asstt.Registrar (Strong Room)

A.C. B 72 PA 72/96 dt. 19/2/96 & 7,8/3/96
B 72/96

csp/7368/96

UNIVERSITY OF PUNE

Circular No. 220 of 1996

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The Principals of all affiliated Colleges in Science where Chemistry is taught , are requested to bring the contents of this circular to the notice of all concerned teachers and students.

for Registrar

Ganeshkhind,
Pune-411 007
Ref.No.CB/583
Date : 12/6/96

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UNIVERSITY OF PUNE

Revised Syllabus for F.Y.B.Sc.Chemistry from 1996-97.

COURSE STRUCTURE :- There will be Two Theory Paper of 100 marks each and one Practical Course of 100 marks. Each theory paper will have two sections. There titles marks distribution and number of lectures to be assigned are as under :-

Paper	Paper I		Paper II	
Titles,	Section I	Section II	Section I	Section II
Number of lectures per week.	(2)	(1)	(2)	(1)
Marks Distribution.	(65)	(35)	(65)	(35)

In the following pages the courses contents are given in as much details as possible. Aims and objectives have been stated. All the course contents have to be taught inlight of this objectives.

The objectives have been further specified by taking suitable examples. This will help the teachers to understand meaning of the objectives. It will help to elevate the teaching,learning and evaluation at the expected level.

(This syllabus is applicable for the Academic year 1996-97)

Paper I : Section : Physical Chemistry

FIRST TERM

GASEOUS STATE : (10 Lectures)

1. Kinetic theory of gases and derivation of the kinetic gas equation, Deduction of gas laws such as Boyle's Law, Charles law, Graham's Law of diffusion, Avogadros Principle, Velocity of gas molecules, Kinetic energy of translational motion. Dalton's law of partial pressures. Distribution of molecular velocities in gaseous state, Average velocity, Most probable velocity, Root mean square velocity and their correlation. Frequency of collisions and mean free path. Non-ideal behaviour of gases - compressibility factor, Boyle temperature, van der Waals' equation of state.

Ref.1 : Chapter - 1, Ref.2: Chapter -6.

OBJECTIVES :

After studying this chapter the students should be able to

(a) Discuss the relationship between the Kinetic energy of one mole of gas and absolute temperature.
(b) State the postulates of Kinetic theory of gases.
(c) Define the R.M.S.Velocity
(d) Derive the kinetic gas equation.
(e) Deduce different gas laws and kinetic energy equation by applying kinetic theory of gases.
(f) Derive the values of R in different units and bring about their interconversions.
(g) Explain the concept of Boltzmann constant.
(h) Explain the most probable velocity on the basis of Maxwell-Boltzmann distribution law.
(i) Interpret the distribution of molecular velocities for different temperatures from the graph of probability of molecular velocity.
(j) Define average velocity
(K) Correlate the average, most probable and root mean square velocity.
(l) Explain the concepts of partial pressure and partial volume.
(m) State and explain Dalton's law of partial pressures.
(n) State the Amagat's law of partial volumes.
(o) Explain graphically the relation between PV against P.
(p) Define the compressibility factor
(q) Explain limitations of kinetic theory of gases with volume and pressure corrections.
(r) State the van der Waal's equation and explain the terms involved in it.
(s) Explain the terms- mean free path and collision freqency
(t) Solve the relevant problems given at the end of the topic.

2. LIQUID STATE : (6 Lectures)

Critical phenomena in liquids, P-V-T Relations of gases and liquids, principle of continuity of states. Application of van der Waals' equation to the isotherms of carbon dioxide, Determination of van der Waal's constants, critical constants of gases, Principle of corresponding states, liquification of gases, Properties of Liquids -vapour pressure, surface tension and viscosity.

Ref. 1 : Chapter 1, Ref.2 : Chapter 8.

OBJECTIVES :

After studying this topic the students should be able to

(a) Explain the importance of temperature and pressure in liquification of gases.

(b) Visualise the liquification as a continuous process.

(c) Derive the relationship between critical constants and van der Waal's constants and solve numerical problems given at the end of the topic.

(d) Understand the properties of liquids such as viscosity, surface tension and vapour pressure from molecular point of view.

3. FOUNDATION FOR CHEMICAL CALCULATIONS : (8 Lectures)

(i) Logarithms : Rules of logarithms (without derivation), Characteristics and mantissa, negative logarithm, application to pH calculations and solving numerical problems involving change of base of logarithm.

(ii) Graphical representation : Graph paper, co-ordinates of a point, equation of a straight line, slope and intercept, plotting of a graph based on experimental data of chemical origin.

(iii) Derivative : Rules of differentation and, partial differentiation (without proof), pertaining to algebraic, logarithmic and exponential functions, examples related to Chemistry.

Ref.3 : Chapters - 1, 4, 7 and 11.

OBJECTIVEs :

After studying this chapter, the students should be able to :-

(a) Define logarithm and state all the rules of logarithms.
(b) Write the logarithms and antilogarithms when number is given.

(c) Convert negative mantissa into positive mantissa.
(d) Calculate pH, pOH, pK_w, pK_a, pK_b etc.
(e) Plot the given data on a graph paper.
(f) Identify the co-ordinates of any point on a graph.
(g) Plot the graph and find the slope and intercept.
(h) Express the equation of the straight line or convert any first order equation in standard form.
(i) Select a proper scale and plot a graph when chemical data are given and find the slope and intercept.
(j) State the rules of differentiation and partial differentiation.
(k) Solve problems of differentiation involving chemical data.
(l) State all the rules of integration pertaining to algebraic logarithmic and exponential functions.
(m) Solve problems of integration related to chemical data.

SECTION II : Inorganic Chemistry

FIRST TERM

1. Principles of oxidation - reduction : (6 Lectures)

i) Defintions of following terms using electronic concept -

a) Oxidation b) Reduction c) Oxidising agents
d) Reducing agents c) Oxidation number.

ii) Rules to find oxidation number

Determination of oxidation number of an element, Difference between oxidation number and valency.

iii) Balancing of redox reactions using -

a) Ion-electron method
b) Oxidation-number method.

Reference :
1) College Chemistry by Linus Pauling Page - 338 to 349
2) University general Chemistry by C.N.R.Rao Page 403 to 407.
3) Numerical problems in Chemistry by Sarine and Sarine P-331 to 349.

Aims & Objectives:

Aim : To study the concept of oxidation and reduction and balance the equations of redox reactions.

Objectives : A student should

i) be able to define the terms oxidation and reduction, oxidizing agent, reducing agent, oxidation number.

ii) identify oxidizing and reducing agent in a given redox reaction.

iii) be able to break a redox reaction in to two half reactions.

iv) assign oxidation number to an element.

v) know the difference between oxidation number and Valency.

vi) be able to balance the equation of a redox reaction by given method.

2. **STOICHIOMETRY** : -(6 Lectures)

Throughout this topic emphasis is to be given on solving problems. The theory behind the problems be discussed in brief. Discription of methods is not expected.

i) Mole concept : Determination of molecular weight by Gram Molecular Volume relationship, problems based on this method only.

ii) Problems based on following reactions -

a) Acid, Base b) Oxidation reduction

c) Precipitation d) decomposition

References:

1) College Chemistry by Linus-Pauling Page 165 to 171.

2) Numerical problems in Chemistry by Sarine and Sarine.

Page-223 to 229, 388 to 410, 418-428.

Aims and objectives:

Aim:

To know the different types of reactions and to study the quantitative relationship between reactions and products.

Objectives: A student should

i) be able to explain the mole concept and GMV relationships.

ii) solve problems on mole concept.

iii) know different types of reactions and solve problems on the reactions.

Section I : Physical Chemistry

SECOND TERM

ATOMIC STRUCTURE : (10 Lectures)

Classical mechanics and electromagnetism, nature of atomic spectra, Failure of the Rutherford model, Dual nature of radiation, Failure of classical electromagnetic theory. Bohr model of the hydrogen atom, Derivation of energy of an electron in an orbit, Radius of an electron orbit, Velocity of an electron, (Ionization energy and ionization potential). Dual nature of matter - failure of classical mechanics, Principles of quantum mechanics, The uncertainty principle, meaning of a wave function, Quantum mechanical model of the hydrogen atom - origin and significance of quantum numbers.

Ref.1 : Chapter 3, ; Ref.2 : Chapter - 3

OBJECTIVES :

After studying this topic the students should be able to:

a) Criticise the Rutherford's model on its success and failure.

b) Explain Bohr's atom model with respect to the purpose, postulates, applications and limitations.

c) Point out the postulate of Bohr's atom model which takes break with classical mechanics.

d) Derive equations for Bohr radius, energy and velocity of an electron in the orbits of the hydrogen and hydrogen like atoms.

e) Solve numerical problems involving use of the equations mentioned in 'd'.

f) State the Ritz combination principle and relate the lines in a spectrum in the light of this principle.

g) Explain the appearance of Lyman, Balmer, Paschen, Braket and Pfund series which constitute the hydrogen spectrum, with the help of the energy level diagram.

h) Explain the purpose of Bohr-Sommerfeld's atom model and its contributions.

i) Explain why the electron paths round the nucleus are called energy levels/quantum levels and existance of empty energy levels.

j) Critically evaluate the Bohr atom model.

k) Explain method of designating an electron in the atomic system and significance of each number caused for the same.

l) State de Broglie's hypothesis

m) Calculate the wave length associated with macroscopic, molecular and subatomic bodies using de Broglie's equation.

n) Explain Heisenberg's uncertaintly principle and calculate the uncertainty associated with measurement of the velocities of macroscopic and subatomic bodies.

o) Explain application of wave nature of electron in the development of wave mechanical model of an atom.

p) Explain in short how Schrodinger arrived at the basic equation of wave mechanics.

q) State Schrodinger's wave equation and explain the meaning of each term involved in it.

r) Describe the hydrogen atom in the light of quantum mechanics.

s) Appreciate the anologies and corelations used in the development of atom models.

t) Explain the wave mechanical model of an atom with respect to the purpose, postulates and applications.

CHEMICAL THERMODYNAMICS : (8 Lectures)

First law of thermodynamics, Reversibility and maximum work, Ideal gas calculations - Relation between H and E,Relation between C_p and C_v, Reversible expansion at constant pressure. Reversible process at constant volume, Reversible process at constant temperature, Joule-Thomson effect. Second law of thermodynamics (Qualitative treatment) Entropy and spontaneity - Irreversible isothermal expansion, Heat flow from higher to lower temperatures, Entropy and disorder, Entropy calculations for phase change only. Trouton's rule.

Ref.1: Chapter - 7
Ref.2: Chapter - 9

a) Make mathematical statements of the first law of thermodynamics with reference to heat exchanged between the surrounding and the system where the system is made up of

1) an ideal gas undergoing-

i) reversible process at constant pressure.
ii) reversible process at constant volume
iii) reversible process at constant temperature.

2) a Pure liquid at the temperature T

i) $T < Tb$ Tb = boiling temperature

ii) $T = Tb$

3) a) Pure solid at the temperature T

i) $T \quad T_m$ T_m = Melting temperature

ii) $T = T_m$

b) deduce the relationship between C_p and C_v

c) Explain the limitations of the first law of thermodynamics and make statements of the 2nd Law of thermodynamics.

d) explain the concept of entropy

e) calculate entropy changes associated with

i) a flow of heat from a body at higher temperature to a body of at lower temperature where both the bodies are isolated from the surrounding.

ii) a chemical change

f) Solve numerical problems given at the end of the chapter.

6. THERMOCHEMISTRY (6 Lectures)

Measurement of thermal changes, Heat of reaction at constant volume or pressure, Thermochemical equations, Calculations of E from H and Vice-versa, Hess's law of constant heat summation, Heat of solution heat of neutralization, Heat of formation of ions, heat of reactions from bond energies, variation of the heat of a reaction with temperature.

Ref.1: Chapter 7

OBJECTIVES :

After studying this chapter, the students should be able to

a) Define the terms heat of formation, combustion, solution, neutralization, etc.

b) Explain what is meant by the standard state of a substance giving examples.

c) State and explain Hess's Law of constant heat summation.

d) Explain Hess's Law as the Chemical version of the first law of thermodynamics.

e) derive the following relations on the basis of the first Law of thermodynamics –

i) heat of reaction and bond energies.

ii) heat of reaction, experimental and resonance energies.

iii) Dependance of the heat of reaction on temperature

iv) heat of reaction and heat of formation.

f) Solve relevant numerical problems given at the end of the chapter.

References : (Physical Chemistry)

Ref.1: Fundamentals of Physical Chemistry by S.Maron and J.Lando, Collier McMillan Publishers, 1974.

Ref.2: University General Chemistry by C.N.R.Rao (Editor) McMillan India, 1973.

Ref.3: Mathematical Preparation of Physical Chemistry by F.Daniels, McGraw Hill Book Company Inc.

Additional references for solving numerical problems of applied level on the concerned topics.

Ref.4: Chemistry Problems by M.J.Senko, Second Edition, W.A.Benjamin Inc., Menlo Park, California.

Ref.5: Elements of Physical Chemistry by S.Glasstone and D.Lewis, Second, Edition, McMillan Education.

Ref.6: University Chemistry by Bruce H.Mahan

3. Bonding and Structure - (12 Lectures)

i) Attainment of stable configuration.

ii) Types of bond a) ionic b) Covalent c) Co-ordinate d) Metallic (Only introduction and Definitions)

iii) Valence Bond Theory -a) Heitler-London Theory (assumptions)

b) Pauling-Slater Theory

c) Concept of atomic orbital overlap and bond formation.

d) Sigma and pi bonds, Types of

Pi bonds - P - P e.g. CO

P - d . SO_2

d d - Ni (PR_3) 4

e) Non polar and polar covalent bonds.

iv) Bonding in following molecules. using pure S and P orbitals.

H_2, F_2, WF, O_2, N_2

v) Hybridization - a) need of hybridization to explain observed covalency and to explain the shape of some molecules.

b) definition of hybridization.

c) Shapes of molecular involving SP, sp^2, sp^3, dsp^2, dsp^3 or sp^3, sd, d^2 sp^3 or sp^3d^2, sp^3d^3, hybrid orbitals

d) bonding and shapes of following molecules. BeF_2, BF_3, CH_4, PCL_5, IF_7, $(Ni(CN)_4)^{-2}$

vi) Valence-Shell Electron-Pair-Repulsion (VSEPR) Theory.
a) Need for the theory - to explain

The irregular geometry of the molecules e.g. H_2, NH^3

b) Assumptions of the theory LP-LP>/L.P.- B.P.>B.P.-B.P.

c) Bonding and shapes of the following molecules.

H_2O, H_2S, NH_3, NF_3, ClF_3.BrF_3,$TiCl_4$

Ref.1: 1) A new guide to Modern Valence Theory by G.I.,Brown (Page 106 to 114, 165 to 168).

2) Concise Inorganic Chemistry by J.D.Lee (Page 48 to 61, 231-241)

3) Basic Inorganic Chemistry by Cotton and Wilkinson (Page 83 to 89).

Aims and Objectives :

Aim : To know the common types of bonds, to know more details about covalent bond and to study bonding and shapes of molecules.

Objectives: A student should -

i) be able to differentiate between different types of bonds and define them.

ii) Know assumptions of valence Bond Theory and its extension to Pauling Slater - Theory.

iii) Know about orbital overlap and bond formation.

iv) Know the formation and difference between a sigma and Pi bond.

v) be able to explain the bonding in a simple molecule.

vi) Know the phenomenon of hybridization and its need,

vii) Explain the bonding in molecules involving hybridization.

viii) Explain the shapes or molecules using VSEPR theory

ix) Predict the shape of molecule, nature of bonding etc. giving reasons.

Paper II: Section I - Organic Chemistry

1. Structure, bonding and reactivity in organic molecules ... (8 Lectures)

- Organic Chemistry - past, present and future - a dynamic perspective (Ref.3).

- Covalent bond, Hybridization in organic molecules (sp, sp^2, sp^3), Intramolecular forces - bond polarity, Polarity of molecules, structure and physical properties, melting point, intermolecular forces, boiling point, solubility (Ref.2).

-Inductive effects (+I,-I), its effect on strength of acids and bases (Ref.2).

-Resonance effects (+R,-R), its effect on strength of acids and bases (Ref.2).

-Resonance structures for Co_2, CO_3^{--}, benzene, phenol, aniline, nitrobenzene and carbonyl compounds to be studied.

-For strength of acids and bases only qualitative treatment be given.

Ref.1: Sections 1.1, 1.8 to 1.11, 1.13, 1.15 to 1.21.

Ref.2: Chapters 1 and 3, relevant pages.

Ref.3: Introduction - pages 1 to 4.

2. Alkanes ...(3 lectures)

-Classification, higher alkanes, homologous series, nomenclature, physical properties, laboratory preparations, reactions of alkanes - combustion, pyrolysis, cracking, analysis of alkanes.

Ref.1: Sections 3.1, 3.6 to 3.15, 3.18,3.19,3.30,3.31,3.33.

3.Alkenes ...(4 lectures)

-Unsaturated hydrocarbons, structures of ethylene, propylene, butylenes, geometrical isomerism (E, Z nomenclatures not to be introduced, only cis, trans to be used), higher alkenes, nomenclature; Physical properties, preparation, orientation and reactivity, reactions of alkenes, analysis of alkenes.

Ref.1: Sections 7.1 to 7.3, 7.5 to 7.12, 7.20,7.25,8.1,8.3,8.5 to 8.8, 8.13, 8.15, 8.22 to 8.24.

4. Alkynes ...(2 Lectures)

- Introduction, nomeclature, physical properties, preparations, reactions of alkynes and analysis.

Ref.1: Sections 11.1, 11.3, 11.4, 11.6 to 11.8, 11.10 to 11.12, 11.14.

5. Benzene

- Aliphatic and aromatic compounds, structure of benzene, Kekule structure, stability of benzene, reactions of benzene ring, aromatic character, Huckel rule (with respect to benzene, naphthalene and anthracene only), nomenclature of benzene derivatives, Reactions - nitration, sulphonation, halogenations and Friedel-Crafts reactions only to be included.

Ref.1: Sections 13.1 to 13.6, 13.10, 13.11, 14.1.

6. Alkyl halides

- Structure of alkylhalides, classification, nomenclature, physical properties, preparations, reactions, analysis of alkyl halides.

Ref.1 : Sections 5.3, 5.4, 5.6 to 5.8, 5.26.

SECOND TERM

7. Alcohols

- Introduction, structure, classification, nomenclatures, physical properties, ethyl alcohol, preparations (organolithium methods to be deleted), reactions of alcohols, analysis of alcohols.

Ref.1: Sections 18.1, 18.2, 18.4 to 18.9, 17.1 to 17.5, 17.8 to 17.11, 17.14 to 17.16.

8. Aldehydes and ketones ..(7 Lectures)

- Structures, nomenclatures, physical properties, methods of preparation (use of organo copper to be deleted), properties, aldol condensations - simple and crossed, analysis of aldehydes and ketones.

Ref.1: Sections 21.1 to 21.5, 21.7 to 21.15, 25.5 to 25.8.

9. Acids and their functional derivatives ..(5 Lectures)

- Structure, nomenclatures, physical properties, salts of carboxylic acids, methods of preparation, properties, names and structures of dicarboxylic acids, analysis of acids.

Functional derivatives of acids - acid chlorides, acid anhydrides, amides, imides and esters, their structures, nomenclatures, methods of preparations and chemical properties, analysis of acid derivatives.

Ref.1: Sections 23.1 to 23.9, 23.15 to 23.21, 24.1 to 24.3, 24.6 to 24.16, 24.20 to 24.22 and 24.24.

10. Amines

- Structures, classification, nomenclature, physical properties, salts of amines, preparation methods, chemical properties, Hoffman orientation in elimination reaction (without E_1/E_2 terminology), analysis of amines.

Ref.1: Sections 26.1 to 26.5, 26.8 to 26.13, 27.1 to 27.2, 27.5 to 27.7, 27.11 to 27.17, 27.19.

11. Phenols

- Structures, nomenclatures, physical properties, salts of phenol, methods of preparation, reactions of phenolic group and ring substitutions (without mechanism), analysis of phenols.

Ref.1 : Sections 28.1 to 28.3, 28.5 to 28.6, 28.8, 28.10 to 28.13.

List of Reference Books :

Ref.1 : Organic Chemistry 5th Edition, Robert T.Morrison, and Robert N.Boyd, Prentice-Hall of India Pvt.Ltd., New Delhi (1989).

Ref.2 : Guide Book to Mechanism in Organic Chemistry, Peter Sykes, 4th Edition, Orient - Longman (1981)

Ref.3 : Organic Chemistry, Francis A. Carey, McGraw-Hill Book Company (1987).

Learning Objectives :

After studying F.Y.B.Sc. Organic Chemistry a student should be able to

(1) appreciate the historical developments of organic chemistry, its versatility in all walks of life and its potential to meet the needs and challenges of tomorrow.

(2) understand the fundamental concepts which govern the structure, bonding, properties and reactivities of organic molecules, such as covalent character, catanation, isomerism, hybridization, bond angles, shapes of molecules, bond polarities, intra- and intermolecular forces and their effects on physical properties, inductive and resonance effects.

(3) name the organic compound when structure is given or vice-versa (common and IUPAC names).

(4) predict the possible structural isomers when molecular formula is given.

(5) convert a given functional group into other functional groups involving one or more number of steps.

(6) convert a given compound into another compound containing more or less number of carbon atoms.

(7) know the characteristic reactions of each functional group which can be used to identify and distinguish that compound from other compounds.

(8) suggest possible structure/s when molecular formula and chemical data is given.

(9) predict the possible product/s when reactant/s are given. In case there are more than one possible products, identify the major and minor ones.

(10) suggest the possible reagent/s to bring about the given conversion.

Specification of learning objectives:

Detailed specification for each of the learning objectives with suitable example is given herewith.

A. Structure, bonding and reactivity part :

1. Student must know and appreciate the important landmarks in the development of organic chemistry such as Berzelius 'vital force' theory, the Friedrich Wohler's urea synthesis which ruled out vital force theory, Kekule's work on structure of benzene, Van't Hoff's suggestion of tetrahedral nature of carbon atom, etc. The student should also be aware of the different areas in which organic chemistry has become important and what are the challenges in the days to come. This will motivate the students to study the subject and inspire them to take up this subject as their career.

2. Understanding of basic principles of structure and bonding in organic molecules is necessary to understand their properties and reactivity. It should be made very clear that properties of molecules are the direct consequences of their structures. Therefore student should be able to explain the bonding in the given organic molecule and be able to specify the bond lengths, bond angles, shape and sketch the structure with all the possible details.

3. Structural effects such as inductive and resonance effects are important in governing the reactivity of the molecules. At F.Y.B.Sc. level, the reactivity is to be restricted to their acid-base behaviour. Similarly structure should also be related to physical properties such as melting points, boiling points, H-bonding, dipole moments etc.

B. Functional group chemistry:

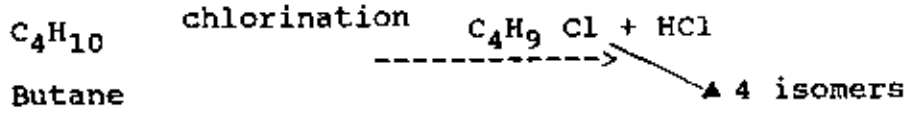
1. Almost all the functional group chemistry which student has studies in Standards XI and XII has been retained. However there is large enrichment as far as the reactions are considered. Many new reactions have been added and even the reactions that have been studied in Standards XI, XII have been exemplified with greater depth.

2. All the functional group chemistry should now be presented with 'synthetic' objective in the mind. More stress has to be given to understanding and application rather than 'information'

and learning by memory.

3. Nomenclature of organic compounds should be taken up seriously. The student should be able to name the given structure or draw the structure as per the name of the molecule. If he is good at nomenclature then only he will be able to grasp the subject properly.

4. He should be able to draw all the possible structural isomers when molecular formula is given e.g. C_4H_9Cl will have 4 structural isomers.



If it is specified that starting C_4H_{10} is n-butane, then there will be only two isomers of C_4H_9Cl. Similarly if given molecular formula is $C_4H_{10}O$, there will be in all 7 isomers, of which three will contain ether group. He should appreciate that there cannot be aldehyde or ketone as the molecule is completely saturated.

5. The student should be able to convert one functional group into another functional group, e.g.

(i) $R-CH_2-Cl \longrightarrow R-CH_2-OH \longrightarrow R-\overset{O}{\overset{\|}{C}}-H \longrightarrow R-\overset{O}{\overset{\|}{C}}-OH$

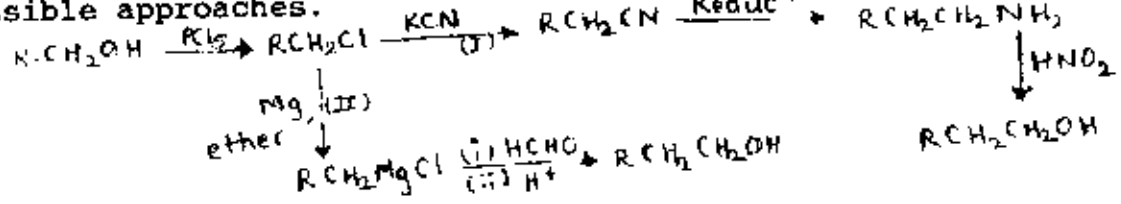
(ii) $R-CH_2-OH \longrightarrow R-CH_2-Br \longrightarrow R-CH_2-C\equiv N \longrightarrow R-CH_2-CH_2-NH_2$

(iii) $R-CH=CH_2 \longrightarrow R-\underset{OH}{CH}-CH_3 \longrightarrow R-\overset{O}{\overset{\|}{C}}-CH_3$

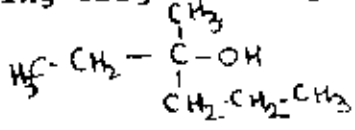
The student should understand the relationship between the functional group and use proper reagents and reaction conditions.

6. The concept of synthesis should be introduced. Starting from smaller molecules, the students should be able to suggest the synthesis of larger molecules and he must know which are the step-up reactions. Some illustrations -

(i) How will you convert $R-CH_2-OH$ into $R-CH_2-CH_2-OH$. Two possible approaches.

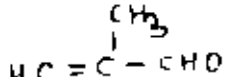


(ii) Suggest possible synthetic route for the following molecule using Grignard reagent.



This is a 3^{o} alcohol and student should be able to suggest three different combinations of Grignard reagents and ketones; all yielding the same target molecule.

(iii) Aldol condensation should never be restricted to acetaldehyde. The student should be in a poisition to write aldol products when other aldehydes or ketones are given along with mixed aldol products, if any. He should appreciate how it can be used to make cyclic products (i.e. intramolecular aldol) and he should be able to suggest starting materials for the given target molecule

e.g. 

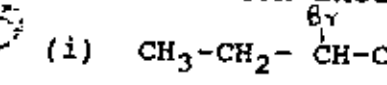
This will be possible by mixed aldol condensation of formaldehyde and propionaldehyde.

7. If molecular formula of an unknown compound and its chemical reactions are given, the student should be able to suggest possible structure of the compound. Use of deductive reasoning is very important in such situations. Some illustrations-

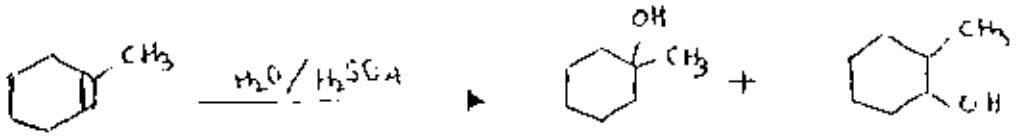
(i) Three isomeric alkanes (C_5H_{12}) A,B,C are subjected to bromination. 'A' reacts to give only one product $C_5H_{11}Br$. 'B' reacts to give three products with same formula $C_5H_{11}Br$ and 'C' reacts to give four isomers of $C_5H_{11}Br$. Suggest structure for A,B,C.

(ii) Compound (C) CPV6PVHPV10PV reacts with bromine in dark to form $C_6H_{10}Br_2$. When it is subjected to ozonolysis it produces compound D ($C_6H_{10}O_2$) which on mild oxidation produces adipic acid. Assign structures for C and D.

8. When reactants and conditions of the reactions are given, the student should be able to predict the possible products. In case there is more than one product, he should be able to comment which should be major or minor. Illustrations are -

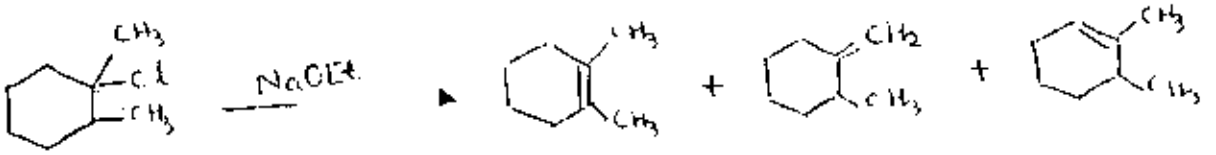
(i) 

There will be in all three products - 1-butene, trans-2-butene and cis-2-butene with trans-2-butene as major product.

(ii) 

major minor

(Markonikoff's product)

(iii) 

major

(Saytzeff product)

9. The functional groups show many characteristic reactions which can be used to distinguish them from others. The students must know these characteristic tests. They are extremely important during the practical work also.

Illustrations –

(i) CH_3CH_2CH , $CH_3\cdot\underset{OH}{\underset{|}{CH}}\cdot CH_3$ and $H_3C-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-OH$

(ii) $R-C\equiv C-H$, $R-C\equiv C-R$

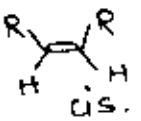
(iii) $R-CHO$, $PhCOCH_3$, $Ph\cdot CH_2\cdot CO\cdot CH_2\cdot CH_3$

10. There are many specific reagents to bring about specific reactions. The student should know these and be able to use them

Illustrations –

(i) $Ph\cdot HC=CH_2 \xrightarrow{\quad ? \quad} Ph\cdot CH_2\cdot CH_2\cdot OH$

Ans.: B_2H_6, NaOH, H_2O_2

(ii) $R-C\equiv C-R \xrightarrow{?}$ 

Ans. : Lindlars catalyst.

Paper II : Organic and Inorganic Chemistry

Section II - Inorganic Chemistry

FIRST TERM

1. Electronic configuration of elements (4 Lectures)

A) Aufbau principle ii) Hund rule of maximum multiplicity iii) shapes of s,p,d orbitals.

Reference : 1) Basic Inorganic Chemistry by Cotton and Wilkinson. page 209 to 216.

2) Advance Inorganic Chemistry By - Satya - Prakash-Tuli

Page 301 to 305, 319 to 324.

3) New Guide to modern valence theory By G.I.Brown Page - 23 to 31 and 71 to 80.

Aim and Objectives :

Aim : To write electronic configuration of elements using aufbau principles.

Objectives = A student should

i) be able to write electronic configuration of elements.

ii) know what is aufbau principle

iii) know Hund's rule of maximum multiplicity and hence the accommodation of electrons in the orbitals.

iv) know the shapes of s,p,d orbitals.

2.Chemistry of Hydrogen (8 Lectures)

i) Position of hydrogen in the periodic table

ii) possible ways of participation of hydrogen in bonding.

iii) Isotopes of hydrogen-Hydrogen, deuterium Tritium. Preparation of deuterium by fractional electrolysis of dilute sodium hydroxide solution.

Preparation tritium by neutron Bombardment of lithium, Industrial manufacture of hydrogen from methane and steam.

iv) Hydrogen bonding in water - exceptionally high boiling of water.

v) Heavy water and its applications preparation of heavy water by electrolysis of dilute solution of sodium hydroxide using Nickel electrodes and applications such a) a tracer in the study of reactions occurring in living organism

b) To prepare deuterium c) In nuclear reactors.

vi) Hard and soft water - distinction between Hard and soft water, Temporary and parmenent hardness of water, degree of hardness, disadvantages of hard water a) In washing b) for boilers c) corrosion d) foaming. Methods of softening of hard water a) Boiling b) Addition of c) Addition of washing soda d) Ion exchange e) demineralisation.

Ref. 1) Basic Inorganic chemistry by Cotton and Wilkinson.

Page - 209 to 216.

2) Advanced Inorganic Chemistry by Sattya-Prakash, Tuli

Page 301 to 305, 311 to 315, 319 to 324.

3) A new Guide to Modern valence Theory by G.I.Brown

Page 23 to 31, 71 to 80.

Aims and Objectives:

Aim : To study the position of hydrogen in the periodic table and properties of hydrogen and water.

Objectives - A student should

i) be able to comment on the position of hydrogen in the periodic table

ii) know the way in which hydrogen can take part in bonding.

iii) know the isotopes of hydrogen and their properties.

iv) know hydrogen bonding and its effect on the properties of water.

v) know about heavy water its properties and applications.

vi) know about hard and soft water and the difference between them.

vii) know the reasons for the hardness of water

viii) know degree of hardness.

ix) know disadvantages of hard water.

x) know methods of softening hard water.

Section II - Inorganic Chemistry

SECOND TERM

3. Long form of the periodic table and periodic properties.

(9 Lectures)

i) Outline of the longform of the periodic table.

ii) Types of elements - inert gas elements, representative elements, transition elements, inner-transition elements.

iii) Blocks in the periodic table s,p,d and f.

iv) Periodic law and periodicity in properties throughout the periodic table (only general trends in each block are expected. Trend in any particular group of any particular period is not expected.)

a) Size of atoms and ions

b) ionization energy

c) electron-affinity

d) electronegativity

e) metallic character and

f) reactivity

vi) Shielding effect and shielding constant, rules to find shielding constant and its examples.

References - 1) Concise Inorganic Chemistry by J.D. Lee (Pages 92 to 97, 99 to 103)

2) A New Guide to Modern Valence Theory by G.I.Brown - (Pages 29 to 31)

Aims and Objectives:

Aims : To know the long form of the periodic table.

To study the variation in properties as a function of atomic number.

Objectives : A student should

i) be able to draw outline of the long form of the periodic table and show position of s,p,d,f blocks and types of elements in it.

ii) know the meaning of the term periodicity.

iii) know the variation at a given property with respect to atomic number, in a group and across the period.

iv) be able to use that property to determine the chemical behaviour of the element.

v) know the meaning of shielding effect and shielding constant.

vi) be able to calculate the screening constant for a given electron.

vii) know the penetration effect of s,p,d and f orbitals.

4) Oxides and Oxyacids (3 lectures)

Oxides - i) definition - binary compounds of oxygen ii) classification of oxides -

a) acidic oxides b) basic oxides c) mixed oxides d) amphoteric oxides e) neutral oxides f) peroxides g) suboxides and h) polyoxides.

Examples of above types of oxides and why are they called so.

Oxyacids

i) definition - compounds of oxygen, hydrogen and other non metals

ii) oxyacids of phosphorus -

a) hypo phosphorus acid - H_3PO_2

b) phosphorus acid - H_3PO_3

c) hypophosphoric acid - $H_4P_2O_6$

d) orthophosphoric acid H_3PO_4

e) meta phosphoric acid - $H_4P_2O_6$.

f) pyrophosporic acid - $H_4P_2O_6$.

names, formulae, (molecular) and graphic structure of above oxyaxids are only expected.

Scheme of Practical Examination

The examination will be of six hours duration

It will be conducted as follows :

a)	Physical Chemistry Expt.	30 Marks
b)	Estimation :	
	i) Inorganic Volumetric	25 Marks
	or	
	ii) Inorganic Quantitative	
	or	
	iii) Inorganic Gravimetric	
c)	Organic Expt.	
	i) Detection of type, functional group and m.p./b.p. of organic compound	12 Marks
	and	
	ii) Crystallisation of organic compound and finding its m.p. before and after crystallisation	13 Marks
	or	
	Organic Volumetric	25 marks
d)	Oral Examination	10 marks
e)	Journal	10 marks
		100 Marks

3. Book/Type Written/Cyclostyled/Printed material will be allowed during the examination.

Practicals :

Important Note : Typed / Printed material will be allowed during the practical examination.

Part A : Physical Chemistry Practicals

1. Determination of equivalent weight of Zn and Mg.
2. Determination of heat of neutralization and heat of ionization.
3. Determination of heat of solution of KNO_3
4. Determination of heat of solution of NH_4Cl
5. Determination of atomic weight of tin by using Dulong and Petit's law.

iii) Oxyacids of sulphur

a) Sulphoxyic acid - H_2SO_2

b) Sulphorous acid - $H_2S_2O_3$

c) Hyposulphurous acid - $H_2S_2O_4$

d) Thiosulphurous acid - $H_2S_2O_2$

e) Pyro sulphurous acid - $H_2S_2O_5$

f) Sulphuric acid - H_2SO_4

g) Thiosulphuric acid - $H_2S_2O_3$.

h) Pyrosulphuric acid - $H_2S_2O_7$

names, molecular formulae and graphic structures of above oxyacids are only expected.

iv) Oxyacids of Chlorine

a) hypochlorous acid - $HClO$

b) chlorous acid - $HClO_2$

c) Chloric acid - $HClO_3$

d) perchloric acid - $HClO_4$

names, molecular formulae and graphic structures of above oxyacids are only expected.

Ref.:
1) Advanced Inorganic Chemistry by Satya-Prakash-Tuli (Page 284 to 287)

2) Concise Inorganic Chemistry by J.D.Lee (Page 244 to 248) 220 to 223, 268 to 270)

Aims and Objectives :

Aims : student should know the type of oxides of the elements, and molecular formulae, graphical formulae and names of some oxyacids of elements - phosphorus, sulphur anc chlorine.

Objectives : students should

i) define oxides and oxyacids

ii) be able to classify them by giving reasons

iii) recognize a given oxyacid by name or molecular formula,

iv) be able to draw a graphical formula of an oxyacid

Practical (Organic Part)

1) Volumetric Estimation of

a) Anilin or Phenol
b) Acetone

(2) Experiments

2) Purification of an impure organic compound by crystallization and determination of its meeting point.

(5) Compounds.

i) Student will report the M.P. of the sample before and after crystallization.

ii) Only water crystallizable organic solids are to be given.

3) Detection of type and functional group in the given organic compound and reporting its melting/boiling point.

(10) Compounds.

The 10 compounds analyzed are to be selected as:

2 acids, - benzoic acid, cinnamic acid, nitrobenzoic acids, succinic acid, oxalic acid, phthalic acid, salicylic acid.

2 bases - Aniline, P-toludine, nitro anilines (o/m/p), and naphthyl amines, N, N-dimethylaniline, cyclohexylamine, Diphenylamine

2 Phenols - α & β - naphthol, phenols, cresols (o/m/p-), nitrophenols (o/m/p-), resorcinol,

4 Neutrals -

1) Hydrocarbons - Benzene, Anthracene, Naphthalene, Xylenes,

2) Aldehydes - Benzaldehyde, cinamaldehyde Glucose.

3) Ketones - Acetone, Ethylmethyl kelone, Acetophenone, Benzophenone, cyclohexanone

4) Esters - Ethylacetate, Aspirin, ethylbenzoate, methylacetate, diethylmalonate,

5) Nitro Compounds : Nitrobenzene, m - dinitrobenzens nitrotoluenes,

6) Amides - Acetanilide, Acetamide urea,

7) Halogen Compounds - Chloroform, Chlorobenzene.

Practicals

Part C: Inorganic Chemistry

1. Description and use of analytical balance.

2. To determine the percentage purity of sodium bicarbonate.

3. To determine water of crystallisation of crystalline barium chloride.

4. To determine water of crystallisation of crystalline magnesium sulphate.

5. Preparation of standard zinc sulphate solution, standardization of E.D.T.A. solution and determination of total hardness of water.

6. (i) Preparation of standard o,1 N Potassium dichromate solution.

   (ii) Standardization of approx 0.1 sodium thisulphate solution with 0.1N potassium dichromate solution.

   (iii) Estimation of copper content in a given solution idometrically.

7. Qualitative analysis of a binary mixture containing two cations and two anion excluding phosphate and borate. Minimum four mixtures be analysed.