APPENDIX to F.Y.B.Sc.
Changes from June, 1990

(1) Chemistry

पुणे विद्यापीठ

परिपत्रक क्र. १७३ १९९०

विषय :—प्रथम वर्ष विज्ञान रसायनशास्त्र सुधारित अभ्यासक्रम.

विद्यापीठ अधिकार मंडळाच्या निर्णयानुसार सर्व संबंधितांच्या माहितीसाठी कळविण्यात येते की, प्रथम वर्ष विज्ञान या साठी सुधारित अभ्यासक्रमास मंजूरी देण्यात आलेली आहे. सुधारित अभ्यासक्रम परिशिष्ट " अ " मध्ये दिलेला असून जून १९९० पासून लागू करण्यात येईल.

गणेशखिंड पुणे ४११ ००७
जा. क्र. सीबीएस । ६५३
दिनांक १८ जून, १९९०

वि. शां. पोळ
कुलसचिवांकरिता

F.Y.B.Sc. Syllabus

1. A new skeleton is suggested at F.Y.B.Sc. level.

F.Y.B.Sc.

(A) There will be two papers, paper I and paper II, For each paper there will be three lectures per week.

Paper I—Will consist of two sections.
Section I—Physical chemistry..2 lectures per week.
Section II—Inorganic chemistry..1 lecture per week.

Paper II—Section I—organic chemistry..2 lectures per week.
Section II—Inorganic chemistry..1 lecture per week.

(B) *Mark distribution*—
Each section will consist of two parts.
Part A—1st term portion. Part B—2nd term portion.

Term end Examination—

(1) Paper I, Section I Physical Chem.	Part A	—	40 marks
Paper I, Section II Inorganic Chem.	Part A	—	20 marks
			60 marks

(2) Paper II, Section I organic Chem.	Part A	—	40 marks
Paper II, Section II Inorganic Chem.	Part A	—	20 marks
			60 marks

Annual Examination—

	Part A + Part B		
(1) Paper I, Section I Physical Chem.			
Physical Chem.	20	+ 34	= 54
Paper I, Section II Inorganic Chem.	10	+ 16	= 26
		Total..	= 80

	Part A + Part B		
(2) Paper II, Section I Organic Chem.	20	+ 34	= 54
Paper II, Section II Inorganic Chem	10	16	26
		Total..	= 80

Total weightage for each subject—

Subject	Lectures per Week	Term end caxm.	Annual exam.
(*a*) Physical .. Paper I Section I	2	40	54
(*b*) Inorganic .. Paper I Sect. II Paper II .. Sect. II ..	1 + 1 = 2	20+20=40	26+26=52
(*c*) Org. Chem. Paper II. Sect I	2	40	54

Note :—All the three branches will be taught throught the year.

F.Y.B.Sc.

PAPER I—PHYSICAL AND INORGANIC CHEMISTRY

SECTION I—PHYSICAL CHEMISTRY

Part A—(*First Term*) :

	Topic	No. of Lectures
1.	Kinetic theory of gases	10
2.	Liquid State	08
3.	Atomic Structure	06
	Total..	24

Part B—(*Second Term*) :

4.	Thermodynamics First law	10
5.	Thermochemistry	08
6.	Fundamentals of Chemical Calculations	06
	Total..	24

SECTION II—INORGANIC CHEMISTRY

Part A—(*First Term*) :

1.	Stoichiometry	06
2.	Principles of Oxidation—reduction	06
	Total..	12

Part B—(*Second Term*) :

3.	Bonding and Structure, Types of Bonds, VBT, Hybridisation etc.	12
	Total..	12

PAPER II—ORGANIC AND INORGANIC CHEMISTRY

SECTION I—ORGANIC CHEMISTRY

Part A—(First Term) :

Topic	No. of Lectures
1. Alkanes	04
2. Alkenes	05
3. Alkynes	03
4. Bezene	03
5. Alkyl halides	04
6. Alcohols	05
Total..	24

Part B (Second Term) :

7. Ethers	03
8. Aldehydes and ketones	06
9. Acids and their Functional derivatives	06
10. Amines	05
11. Phenols	04
Total..	24

SECTION II INORGANIC CHEMISTRY

Part A—(First Term) :

1. Electronic Configuration of atoms	04
2. Chemistry of Hydrogen	08
Total..	12

Part B—(Second Term) :

3. Long Form of the Periodic Table and Periodic Properties	09
4. Oxides and Oxyacids	03
Total..	12

DETAILS OF THE TOPICS AND THE OBJECTIVES OF TEACHINGS

PAPER I—SECTION I—PHYSICAL CHEMISTRY

Part A—(First Term) :

1. *Atomic Structure (A) Topic Details*—(6 *Lectures*) :

: Rutherfords experiments, observations, his model of atom drawbacks.

The charge on the nucleus, Prouts theory, Moseley's work discovery of neutron, number of extra nuclear electrons and atomic number. Line spectra of atoms, Ritz combination principle, examples, Bohr's Theory, assumptions, derivation of energy of electron in an orbit, radius of an electron orbit, velocity of electron, applications of atomic spectra, failure of Bohr model, Quantum numbers and distribution of electrons.

Ref. 1 Chapter 3, Ref. 2 Chapter 3.

(*B*) *Objectives :*

After studying this topic the student should be able to :

(*a*) Explain the Rutherfords α–scattering experiment.
(*b*) Interprete the observations of the α–scattering experiment.
(*c*) Explain the Rutherfords model on the basis of his experiment.
(*d*) Criticize the Rutherfords model on its success and failure
(*e*) Explain the Moseley's experiment.
(*f*) Show the Variation of the square root of frequencies of X–rays emitted with atomic number.
(*g*) Explains the Prouts theory and its limitations.
(*h*) Knows the Moseleys equation and explains the significance of the terms *a* and *b*.
(*i*) State the conclusion of the Moseley's work.
(*j*) Explain the line spectrum of an atom, band spectrum of the molecule, the absorption and emission spectrum.
(*k*) Explain the prediction of the existance of neutron by Rutherford and its discovery by Chadwick.

(*l*) State the Ritz combination principle and relate the spectrum inlight of this principle.

(*m*) Discuss the origin of Lyman, Balmer, Paschen, Bracket and fund series of hydrogen atom.

(*n*) State and explain assumptions of Bohr theory.

(*o*) Derive the expression for energy of an electron in an orbit and redios of Bohr orbit.

(*p*) Solve the numerical problems involving the radius, energy and velocity of an electron in an orbit.

(*q*) Evaluates the Bohr's theory with respect to its merits and demerits.

(*r*) Explain the quantum numbers.

(*s*) Identify the quantum numbers of any given electron in an atom.

(*t*) Indicate the electronic configurations of an atom when atomic number is given.

(*u*) Solve the relevent problems given at the end of the topic

2. *Gaseous state Kinetic theory of gases* (10 *lectures*) :

(A) *Topic Details* :

Assumptions of Kinetic theory of gases, RMS Velocity, derivation of Kinetic theory of gases, derivation of kinetic gas equation, deduction of Grahm's law, Charles law, Avagadre's principle Grahm's law, Velocity of gas molecules, Kinetic energy of translational motion from the kinetic gas equation, Dalton law of partial pressure, distribution of molecular velocities in gas, average and most probable velocity, relationship between the RMS and most probable and average velocity.

Applicability of ideal gas laws, compressibility factor, Boyle's temperature, use of compressibility factor, Vanderwaal's equation of state :

Ref.—1 Chapter 1

Ref.—2 Chapter—6

(B) *Objectives* :—After studying this chapter, the student should be able to—

(*a*) Discuss the relationship between the kinetic energy and absolute temperature.

(*b*) State the postulates of kinetic theory of gases.

(*c*) Define the RMS velocity.

(*d*) Derive the kinetic gas equation.

(*e*) Duduce the different gas laws and kinetic energy by applying kinetic theory of gases.

(*f*) Derive the different values of R in different units and bring about their interconversion.

(*g*) Explain the concept of Boltzman constant.

(*h*) Explain the most probable velocity on the basis of the Maxwell–Boltzmann distribution law.

(*i*) Interprete the distribution of molecular velocities for different temperature from the graph of probability of molecular velocity.

(*j*) Define average velocity.

(*k*) Correlate the average, most probable and RMS velocity.

(*l*) Explain the partial pressure and partial volume.

(*m*) State and explain Dalton's law of partial pressure.

(*n*) State the Amagat's law of partial volumes.

(*o*) Explain graphically the relationship between PV against P w.r.t. ideal and real gases.

(*p*) Define compressibility factor.

(*q*) Explain the limitations of kinetic theory with volume correction and pressure correction.

(*r*) Give the Vanderwaal's equation and explain the terms involved in it.

(*s*) Solve the relevant problems given at the end of the topic.

3. *Liquid State* :—(8 Lecture)

(A) Topic Details

Liquids, P–V–T relations of gases and liquids, Andrew's experiment, principle of continuity of state, application of Vander Waal's equation to the isotherms of carbon dioxide, determination

of VanderWaal's constant, critical constants of gases, principle of corresponding state, liquification of gases, properties of liquids volume, density, compressibility vapour pressure surface tension, viscosity.

Ref. -1 Chapter--2

Ref.—2 Chapter 8

(B) *Objectives* : -After studying this topic, the stud[illegible] should be able to—

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

(*b*) Visualize the liquification as a contineous process.

(*c*) Derive the interrelation between critical constant and Vanderwaal's constant and solve numerical problems given at the end of the topic.

(*d*) Understands the properties of liquids such as viscosity, surface tension from molecular point of view.

Part B- (Second Term) :

4. *Thermodynamics* :—First law of thermodynamics (10 lectures)

Thermodynamic system, properties and variables of a system first law of thermodynamics, reveribility and maximum work, enthalpy, heat capacity, isothermal and adiabatic process, isothermal and adiabatic processes in ideal gases, Joule-Thomson effect.

Ref.—1 Chapter 7

Objectives :—After studying this chapter, the student sho[illegible] be able to—

(*a*) Understand different systems such as open, closed isolated; homogeneous, heteregeneous.

(*b*) Understand the relotionship between the system and the surroundings.

(*c*) define and explain 'phase'.

(*d*) know properties of system like extensive and intensive and variables like pressure, volume and temperature.

(*e*) explain the thermodynamic functions, path function, state function.

(*f*) state and explain different statements of the first law and express it by mathematical expression.

(*g*) prove that the thermodynamic properties such as E, N are state functions.

(*h*) calculate the workdone during reversible and irreversible process.

(*i*) explain the concept of maximum work.

(*j*) calculate the enthalpy changes and internal energy changes in a process.

(*k*) explain Cp and Cv and derive their relationship.

(*l*) compare isothermal and adiabatic process.

(*m*) derive the expression for maximum work in a isothermal, reversible process.

(*n*) derive the expression $P_1V_1^{\gamma} = P_2V_2^{\gamma}$ and solve numerical problems based on it.

(*o*) explain Joule-Thomson effect, Joule-Thomson coefficient, inversion point and inversion temperature.

(*p*) explain the importance of Joule-Thomson effect.

(*q*) solve the relevant problems given at the end of the chapter.

5. *Thermochemistry* :—(8 lectures) :

Measurement of thermal changes, heats of reation at constant volume and pressure, thermochemical equations, calculation of energy changes and enthalpy change, Hess's law, heat of formation, heat of combustion, heat of solutions, thermoneutrality of salt solutions, heat of neutralization, heat of formation of ions, heat of reactions from bond energies, variation of heat of reaction with temperature.

Ref.—1 Chapter—7

Objectives :—After studying this chapter, the student should be able to—

(*a*) define the terms heat of formation, combustion, solution, neutralization.

(*b*) explain what is meant by standard state of the substance giving examples.

(*c*) state and explain the Hess's law.
(*d*) explain Hess's law as the chemical version of 1st law of their Thermodynamics.
(*e*) derive the following relations on the basis of 1st law :
(i) relation between heat of reaction and bond energy.
(ii) debendance of heat of reaction on temperature.
(iii) heat of reaction and heat of formation.
(*f*) solve the relevant numerical problems given at the end of the chapter.

6. *Fundamentals of Chemical Calculations* : (6 lectures) :
(i) *Logarithms* :—rules of logarithms without derivation, characteristic and mantissa negative logarithm, application to pH calculations and solving numerical problems involving change of base of logarithm.
(ii) *Graphical representation* :—graph paper, coordinates of point, equation of straight line, slope and intercept, characteristics of straight line, plotting of graphs based on experimental data of chemical origin.
(iii) Derivative-rules of differentiation, partial differentiation, without proof pertaining ot algebric, exponential and logarithmic functions, examples related to chemistry.
(iv) Integration-rules of integration without proof pertaining algebric and exponential functions, examples relating to chemistry.

Ref.– 3 Chapter—1, 4, 7, 11.

Objectives :—After studying this chapter, the student should be able to —

(*a*) define logarithm and state all the rules of logarithms.
(*b*) write the logarithms and antilogarithms when numbers is given.
(*c*) convert negative mantissa in to positive mantissa.
(*d*) calculates pH, pOH, pKW, pKa, pKb, etc.
(*e*) plot the given data on a graph paper.
(*f*) indentify the coordinates 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 is given and find the slope and intercept.

(*j*) state the rules of differentiation and partial differentian pertaining to algebric logarithmic and exponential functions.

(*k*) solve problems of differentiation involving chemical data.

(*l*) state all the rules of integration pertaining to algebric, logarithmic and exponential functions.

(*m*) solve problems of integration related to chemical data.

Ref. 1—Fundamentals of Physical Chemistry by S. Maron and J. Lando Collier-Macmillan, International Edition, 1974.
Ref. 2—University General Chemistry Editor—C.N.R. Rao.
Ref. 3—Mathematical preparation of Physical Chemistry by F. Daniels McGraw Hill book company Inc.

PAPER I, SECTION II—INORGANIC CHEMISTRY

Part A—(*First Term*) :

1. *Principles of oxidation reduction* :—(6 lectures) :

(i) Definitions of the following terms using electronic concept. (*a*) oxidation, (*b*) reduction, (*c*) oxidising agent, (*d*) reducing agent, (*e*) 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.

Ref. 1—College Chemistry by Linus Pauling, Page 338 to 349.
2. University General Chemistry by CNR Rao Page 403 to 407.
3. Numerical Problems in Chemistry by Sarin and Sarin Page 331 to 341.

Aim and Objectives :

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

Objectives :—A student should,

(i) be able to define the terms oxidation, reduction oxidising agent, reducing agent, ox. no.

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

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

(iv) Assign ox. no. to an element.

(v) know the difference between ox. no. and valency.

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

2. *Stochiometry* :—(6 lectures) :

Throught this topic emphasis is to be given in solving problems. Description 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 reacions.

(*a*) Acid-base, (*b*) Oxidation-reduction, (*c*) Precipitation (*d*) Decomposition, (*e*) Displacement.

Ref. 1. College Chemistry by Linus Paulling
Page No. 165 to 171.

2. Numerical Problems in Chemistry by Sarin and Saria, Page No. 23 to 229, 388–410, 418–428.

Aim and Objectives :

Aim :—To know the different types of reactions and to study the quantitative relationship between reactantants and products.

Objectives :—A student should :

(i) be able to explain the mole concept and G.M.V. relationship.

(ii) Solve problems on mole concept.

(iii) Know different types of reaction and solve problems on these reactions.

Part B—(*Second Term*) :

3. *Bonding and Structures* :—(12 lectures) :

(i) Attainment of stable configuration.

(ii) *Types of bond*—(*a*) Ionic, (*b*) Covalent. (*c*) Coordinate (*d*) Metallic (only introduction and definitions).

(iii) *Valence Bond Theory* :—(*a*) Heitler-London Theory (assumptions). (*b*) Pauling-slator theory, (*c*) concept of atomic orbital overlap and bond formation, (*d*) sigma and pi bonds, (*e*) Non-polar and polar covalent bond.

(iv) Bonding in following molecules using pure S and P orbitals H_2, F_2, HF, O_2, N_2.

(v) *Hybridisation* :—(*a*) Need of hybridisation-to explain the observed covalency and to explain the shape of some molecules. (*b*) definition of hybridisation, (*c*) shapes of molecules involving sp, sp^2, sp^3, dsp^2, dsp^3 or sp^3d, d^2sp^3 or sp^3d^2, sp^3d^3, hybrid orbitals, (*d*) bonding and shapes of the following molecules, BeF_2, BF_3, CH_4, PCl_5, SF_6, IF_7, $[Ni(CN)_4]^{-2}$.

(vi) *Valence shell. Electron Pari Repulsion* (*VSEPR*) *Theory* :

(*a*) Need for the theory-to explain the irregular geometry of the molecules e.g. H_2O, NH_3.

(*b*) Assumptions of the theory-L.P.-L.P. 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, XeF_2 XeF_4, BrF_5, $TeCl_4$.

Ref. 1. A New Guide to Modern Valency Theory by G.I. Brown, Page 106 to 114, 165 to 168.

2. Concise Inorganic Chemistry by J.D. Lee, Page 48 to 61.

3. Basic Inorganic Chemistry by Cotton and Wilkinson, Page 83 to 85.

Aim 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 simple molecule.
(vi) know the phenomenon of hybridisation and its need.
(vii) explain the bonding in molecules involving hybridization.
(viii) explain the shapes of molecules using VSEPR theory.
(ix) Predict the shapes of molecule, nature of bonding etc. giving reasons.

PAPER II, SECTION I -ORGANIC CHEMISTRY

Part A (First Term) :

1. *Alkanes* : (4 lectures) :

Classification by structure-higher alkanes-the homologous series, nomenclature-physical properties-classes of carbon atoms and hydrogen atoms, industrial source, laboratory preparation. Grignard reagent-Reactions of alkanes, combustion, pyrolysis-cracking-determination of structure, analysis of alkanes.

Ref. 1, 3.1, 3.6 to 3.16, 3.18, 3.19, 3.30 to 3.33.

2. *Alkenes* : (5 lectures) :

Unsaturated hydrocarbons-structure of ethylene, propylene, butylenes, the hybridisation and orbital size, geometrical isomerism (E and Z nomenclatures not to be introduced. Cis and trans to be used) higher alkenes, names, physical properties, industrial source, preparation, orientation and reactivity (E_1 and E_2 terminology not to be used).

Reactions of alkenes, analysis of alkenes.

Ref. 1. 7.1 to 7.12, 7.20, 7.25, 8.1, 8.3, 8.5, to 8.8, 8.13, 8.15, 8.16, 8.22 to 8.24.

3. *Alkynes* :—Introduction, structure of c ≡ c, nomenclature, physical properties, industrial source, preparations, reactions of alkynes, analysis of alkynes.

Ref. 1. 11.1 to 11.12, 11.14.

4. *Benzene* :—(3 lecures) :

Aliphatic and aromatic compounds, structure of benzene, kekule structure, stability of benzene ring-reactions of benzene (e g, aromatic character. The huckel rule (w.r.t. benzene only), nomenclature of benzene derivatives, (in reactions, only nitration sulphonation, halogenation & Friedal-craft reactions to be included).

Ref. 1. 13.1 to 13.4, 13.6, 13.10, 13.11, 14.1.

5. *Alkyl Halides* :—(4 lectures) :

Structure of alkylhalides-classification and nomenclature, physical properties-preparation, reaction-analysis of alkyhalides.

Ref. 1. 5.3, 5.4, 5.6 to 5.8, 5.26. 2. Page 168–172.

6. *Alcohols* :—(5 lectures) :

Introduction, structure, classification, nomenclature, physical properties, industrial source, ethylalcohol. preparation, (organo lithium to be deleted), reactions of alcohols, analysis of alcohols.

Ref. 1. 18.1, 18.2, 18.4–18.9, 17.1 to 17.11, 17.14 to 17.16.

Ref. 2. Page nos 309, 316, 317–only methods of preparations. organo lithiums to be omitted.

Part B—(*Second Term*) :

7. *Ethers* :—(3 lectures) :

Structure and nomenclatures, physical properties, industrial source preparation, reactions, cyclic ethers, general information of crown ethers. Ref. 1. 19.1 to 19.7, 19.9, 19.10.

8. *Aldehydes and Ketones* :—(6 lectures) :

Structures, nomenclatures, physical properties, preparations (use of organo coppers to be deleted) reactions.

Aldol condensation-analysis of aldehydes and ketones.

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

9. *Acids and Their functional Derivatives* :—(6 lectures) :

Structure, nomenclature, physical properties, salts of carboxylic acids, industrial source, preparations, reactions of acids.

Functional derivatives of acids-nomenclature, physical properties, preparation and properties of acid chlorides and antihydrides-amides-imides, esters, analysis of acid derivatives.

Ref. 1. 23.1–23.9, 23.15 to 23.21, 24.1 to 24.3, 24.6 to 24.16, 24.19, 24.21, 24.22, 24.24.

10. *Amines* : –(5 lectures) :

Structure, classification, nomenclature, physical properties, salts of amine, industrial source, preparation, reactions-Hofmann orientation (without E_2/E_1 terminology)-analysis of amines

Ref. 1. 26.1 to 26.5, 26.7 to 26.13, 27.1, 27.2, 27.5 to 27.7, 27.11 to 27.17, 27.19.

11. *Phenols* : -(4 lectures) :

Structure, nomenclature, physical properties, salts of phenol, industrial source, preparation, reactions-analysis.

(ring substitutions to be introduced without mechanism).

Ref 1. 28.1 to 28.6, 28.8 to 28.10 to 28.13.

Objectives : -After studying F.Y.B.Sc. Organic Chemistry, the students should be albe to

(*a*) Name the organic compounds when structure is given or vice-versa (common names and I.U.P.A.C. names).

(*b*) Predict the possible structural isomers when molecular formula is given.

(*c*) convert a given functional group in to other functional groups involving one or more number of steps

(*d*) convert a given compound into other compound w. more or less number of carbon atoms

(*e*) know the characteristic reactions of each functional group Which can be used to identify and distinguish that compound from other compounds

(*f*) suggest possible structure or structures when molecular formula and chemical data is given.

(*g*) Predict the possible product/s when reactions are given. In case there are more than one possible products, he is able to suggest which would be major and minor products.

General Instruction :

(1) Reference Book 1—Organic chemistry by Morrison and Boyd, 5th edition (1989).
Reference Book 2—Organic chemistry vol. 1 by Finar, 6th edition.

(2) Mechanistic approach and thermodynamic details are to be deleted for *all the* topics.

(3) The relevent problems from Ref. 1 should be discussed in the class after the completion of each topic.

PAPER II, SECTION II—INORGANIC CHEMISTRY

Part A—(First Term) :

1. *Chimestry 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 of tritium—by neutron bombardment of lithium. Industrial manufacture of hydrogen from methane and steam.

(iv) Hydrogen bonding in water—exceptionally high boiling point of water.

(v) Heavy water and its applications.

Preparation of heavy water-by electrolysis of dilute solution of sodium hydroxide using Nickel electrodus. Application such as (*a*) a tracer in the study of reactions occuring in living organisum (*b*) to prepare deuterium, (*c*) In nuclear reactors, (*d*) Hard and soft water.

Distinction between hard and soft water—

Temporary hardness and permanent hard water. Degree of hardness, disadvantages of hard water (*a*) In washing, (*b*) For boilers, (*c*) Corrosion, (*d*) Foaming.

Methods of softening the hard water—

(*a*) boiling, (*b*) addition of lime, (*c*) addition of washing soda, (*d*) Ionexchange, (*e*) demineralisation.

Ref. 1. Basic Inorganic chemistry by Cotton and Wilkinson page 209–216.

2. Advanced Inorganic chemistry by Satya-Prakash Tuli, Page No. 301–305, 311–315, 319–324

3. New Guide to Modern valence. Theory by G. I. Brown, Page No. 23–31. 71–80.

(1) *Aim 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 disadvantage of hard water. (x) know methods of softening hard water.

2. *Electronic Configuration of Elements :* (4 lectures) :

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

Ref. 1. Basic Inorganic chemistry, by Cotton and Wilkinson Page 209 216.

2. Advanced Inorganic chemistry by Satya-Prakash Tuli, Page 301–305, 319–324.

3. New Guide to Modern Valence theory by G.I. Brown Page, 23–31. 71–80.

Aim and Objectives :

Aim :—To write electron configuration of elements using aufbau principle.

Objectives :—A student should.

(i) be able to write electron configuration of elements, (ii) know what is Aufbau principle, (iii) know Hund's rule of maximum multiclicity, (iv) know the shapes of s, p, d orbitals.

Part B—(*Second Term*) :

Long form of the periodic table and periodic properties :— (5 lectures).

(i) Outline of the long form of periodic table.
(ii) Types of elements-inert gas elements representative elements. Transition elements, Innertransition elements
(iii) Blocks in the periodic tables, s, p, d and f.
(iv) Periodic law and periodicity in properties throught the periodic table i.e. including s, p (only general trends in each block are expected. Trend in any particular group or any particular period is not expected), (*a*) size of atoms and ions, (*b*) Ionisation energy. (*c*) Electron affinity Electrongativity.
(v) Metallic character and
(vi) Reactivity.

Ref. 1. Concise Inorganic chemistry by J.D. Lee, Page 92–97 and 99 to 103.
2. A New Guide to Modern Valency Theory by G.I. Brown. Page 29, 30, 31.

Aim and Objectives :

Aim :—To know the long form of the periodic table and 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 period table and show position of s, p, d, f, block and types of elements in it, (ii) know the meaning of the term periodicity, (iii) know the variation of a given property with respect to atomic number in a group and acrods the period, (iv) be able to use that property to determine the chemical behaviour of the element.

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, (iv) Amphoteric oxides, (v) Neutral oxides, (vi) peroxides, (vii) Sub-oxides, (viii) Poly oxides.

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

Oxyacids :—

(i) Definition-compounds of oxygen, hydrogen and another non-metal, (ii) Oxyacids of phosphorus :—(*a*) Hypophosphorus acid —H_3PO_2, (*b*) Phosphorus acid —H_3PO_3, (*c*) Hypophosphoric acid —$H_4P_2O_6$, (*d*) Orthophosphoric acid H_3PO_4, (*e*) Metaphosphoric Acid —$H_4P_2O_6$, (*f*) Pyrophosphoric acid —$H_4P_2O_7$.

Names, formulae (molecular) and graphic structures of above oxyacids are only expected.

(iii) Oxyacids of sulphur—(*a*) Sulphoxylic 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*) Pyrosulphurous 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.

Ref.

(iv) Oxyacids of clorine—(*a*) Hypochlorus 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. Advance Inorganic Chemistry by Satya Prakash, Tuli, Page 284–287.

2. Concise Inorganic Chemistry by J.D. Lee, Page 220 to 225, 244 to 248, 268 to 270.

Aim and Objectives :—

Aim :—To know the types of oxides of elements and to know molecular formulae, graphical formulae and name of some oxyacids of the elements P, S, and Cl.

Objectives :—A student should—(i) define oxide and oxyacid (ii) be able to classify a given reason, (iii) recognise a given oxyacid by name or molecular formula, (iv) be able to draw graphical formula of an oxyacid.

F.Y.B.Sc. Practicals

Imp. Note—**No book will be allowed during the practical examination.**

Part A—Physical Chemistry Practicals :

1. Determination of Viscosities of a pure liquids and inbinary mixtures.
   (Alcohol + Water) and (Glycerine + Water).
2. Determination of equivalent Wt. of Zn and Mg.
3. Heat of neutratization and heat of ionization.
4. Determination of Mol. Wt. by Victor—Meyer's method.
5. Surface tension of liquids using stalagmometer.
6. Heat of solution of KNO_3 and NH_4Cl.
7. Determination of atomic Wt. by using Dulong and Petit's law.

Part B—Organic Chemistry Practicals :

1. Determination of Physical constant (M.P./B.P.) of given organic compound.
2. Identification of the functional groups in the given organic compound. Atleast 10 compounds must be analyzed. Following functional groups and tests are suggested.

(*a*) $c = c$ test for unsaturation, Baeyer test ($KMnO_4$) and Br_2 water *compounds—Cinnamic acid, styrene, cyclohexene, 2, 3, dimethyl–2–butene.

(*b*) —OH *alcohol* primary. secondary, tertiary-tests–Iodoform, Lucas test.

Compounds-Ethanol, Isopropyl alcohol, n-propyl alcohol, Methanol, Benzylalcohol, tertiary bytyl alcohol, Cyclohexamol etc.

(*c*) —OH—Phenolic.

Test—(i) Solubility in NaOH and regeneration of Phenol by acidification, (ii) $FeCl_3$ test, (iii) Phthalein test, (iv) Bromination test.

Compounds—Salicylic acid, Phenol, α–Naphthol, β–Napthol, Resorcinpl, nitro phenols, P–Cresol etc.

(water insoluble phenols should be preferred).

(*d*) –COOH Acids.

Test—(i) Solubility in $NaHCO_3$ with CO_2 evolution, regeneration by acidification, (ii) Esterification.

Compounds–Benzoic, Salicylic, Aspirin, Phthallic, Cinnamic Nitrobenzoic acids, toluic acids, anisic acid, etc.

(water insoluble acid sshould be preferred).

(*e*) Aldehydes and ketones-

Tests—(i) 2 : 4 DNP, (ii) Tollen's (iii) Fehling Solution (iv) Iddoform test, (v) Schiff's reagent.

Compounds—Ethyl methyl ketone, Benzophenone, Acetone, Benzaldehyde Acetophenone, Salicy ladehyde, Cyclohexanone, etc.

(*f*) –COOR Esters.

Test—(i) Phenolphthalein test, (ii) Hydroxamic test.

Compounds–Methyl acetate, ethylacetate, Methyl benzoate ethylbenzoate, Methyl Salicylate etc.

(*g*) $CONH_2$ Amides.

Test—Termeric paper-Evolution of NH_3.

Compounds–Acetamide, Benzamide, Urea etc.

(*h*) Anilides—Ph–NH–CO–R.

Tests—Hydrolysis followed by dia zotization.

Compounds—Benza nilide, Acetanilide.

(*i*) NH_2, —NH–R, NR_2 Amines, Primary, Secondary and Tertiary.

Tests—Test with HNO_2. (diaxotyzation).

Compounds—Aniline, p–Toludine nitroanilines (o, m, p.), Dimethyl aniline, diphenyl amine, triethyl mine, trin ethyl amine etc.

(ii) —NO_2 Compounds.

Test—Neutral reduction test.

Compounds—Nitro phenols, nitroanilines, nitrobenzene, m. dinitrobenzene etc.

3. *Organic Estimations ; Four Estimations :*—(4 practicals) :

Phenol, Aniline Acetone, glucose.

Ref. book for functional gr-tests. laboratory methods in organic chemistry.

By Soloman Marmor, Surjeet publications, New Delhi.

Part C—Inorganic Chemistry Practicals :

1. Description and use of Analytical balance.
2. Qualitative analysis of a powder containing one cation and one anion including phosphate and borate. At least ten compounds must be analysed.
3. To determine the percentage purity of Sodium bicarbonate.
4. To determine the water of crystalisation of crystalline Barium chloride.
5. To determine the water of crystallization of crystalline Magnesium Sulphate.
6. Preparation of standard zinc sulphate solution, standardisation of EDTA solution and determination of total hardness of water.
7. Preparation of sodium thisulphate solution, its standardisation with standard 0.1 N Potassium diachromate solution and estimation of copper content in a given solution iodometrically.

SCHEME OF PRACTICAL EXAMINATION

1. The examination will be of six hour duration.
2. It will be conducted as follows:

(*a*) Physical chemistry expt.	30 marks
(*b*) Estimation.	25 m
(i) Inorganic Volumetric.	
or	
(ii) Inorganic gravimetric.	
or	
(iii) Organic Volumetric.	
(*c*) Quatitative analysis of.	
(i) one Inorganic compound.	13 marks
(ii) one organic and compound alongwith M.P./B.P.	12 marks
(*d*) Oral examination	10 marks
(*e*) Journal.	10 marks
	100 marks

3. No Book/Cyclostyled or typewritten or hand written material will be allowed to use during the practical examination.

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