

University of Poona

Syllabi for the Three-Year Integrated B.Sc.

Degree Course "85 Pattern"

(Non-Semester)

Third Year B.Sc.

CHEMISTRY

(From June 1988)

The T.Y.B.Sc. Chemistry class shall have six theory papers and three practical courses. Out of six theory papers the following five papers shall be compulsory.

1. Paper V —Physical Chemistry
2. Paper VI —Inorganic Chemistry
3. Paper VII —Organic Chemistry
4. Paper VIII —Analytical Chemistry OR "C" Component for restructuring
5. Paper IX —Industrial Chemistry
6. The students shall select any one of the following Optional papers.

- Paper X —A —Petrochemicals and Polymers
 B —Nuclear and Environmental Chemistry
 C —Fundamentals of Biochemistry and Molecular Biology and Drugs and Pharmaceuticals
 D —Introduction to Biochemistry and Molecular Biology
 E —Agriculture and Dairy Chemistry

The college may impart instruction in one or more Optional papers depending on their resources and expertise.

Practicals :—There shall be three practical courses as follows :

- Chemistry (1) Physical Chemistry Practicals,
 (2) Inorganic Chemistry Practicals,
 (3) Organic Chemistry Practicals.

The final University examination for each of the three practical courses will be of six hour's duration.

(Total T.Y.B.Sc. Practical examination : 18 hours).

The quantities of various Chemicals used in all practical work including final examinations should be reduced to the minimum considering the spiralling cost of chemicals.

Paper V : Physical Chemistry

SECTION I

1. *Kinetics of homogeneous reactions* :—

Measurement of reaction rates order and molecularity of reactions, first order reactions and their examples, second order reactions and their examples; pseudomolecular reactions, effect of temperature on reaction velocity, the energy of activation. (12)

(Ref. 1—Chapters 13, Page No. 548-564, 571-574.)

2. *Photochemistry* :—

The Grotthus-Draper law, the Einstein law of photochemical equivalence, Consequences of light absorption by atoms, Consequences of light absorption by molecules, experimental study of photochemical reactions, Photochemical gas reactions, Ph^{γ} sensitized gas reactions. (10)

(Ref. 1—Chapter 19, Page No. 775-781, 784-789.)

3. *Investigation of Molecular Structure* :—

The molar refraction, electrical polarization of molecules, permanent dipole moments, determination of dipole moments, molecular structure and dipole moments, molecular spectra, rotation, spectra, microwave spectroscopy, vibration-rotation spectra, electronic spectra, Raman spectra. (14)

(Ref. 1, Chapter 16, Page No. 691-711.)

4. *Crystal Structure* :—

Crystallography, properties of crystals, polymorphism, the structure of crystals, Laue method Bragg method of crystal analysis, X-ray analysis of sodium chloride, Positions of Na⁺ and Cl⁻ ions in lattice. Calculation of 'd' and 'A'. (12)

(Ref. 1, Chapter 2, Page No. 67 to 85.)

SECTION II

1. *Solutions* :—

Vapour pressure of ideal solutions, Vapour pressure of actual liquid pairs, Boiling point diagrams of miscible binary mixs, Distillation of binary miscible solutions, Azeotropes, Fractionating columns, Solubility of partially miscible liquid pairs, Vapour pressure and distillations of immiscible liquids, the Nernst distribution law. (10)

(Ref. 1, Chapter 8, Page No. 272-286, 288-291, 294-296 and 298-302.)

2. *Electrolytic Conductance* :—

Electrolytic conductance, Determination of conductance; Variation of conductance with concentration, Equivalent conductances at infinite dilution, Effect of other factors on conductance, Application of conductance measurements, Activity and activity coefficients of strong electrolytes, Determination of activity coefficients. (10)

(Ref. 1, Chapter 11, Page No 414-424, 431-438)

3. *Electrochemical cells* :—

Reversible and irreversible cells, EMF and its measurement, Standard cells, Cell reaction and EMF, Convention regarding sign of EMF, Single electrode potentials, calculation of single electrode potentials, Calculation of cell EMF, Thermodynamics and EMF, Thermodynamics of electrode potentials, Standard potentials and

equilibrium constant, Classification of electrodes, Electrochemical cells (Classification only.)

Potentiometric determination of PH, Potentiometric titrations.

(16)

(Ref. 1. Chapter 12, Page No 471-497, 514-520.)

4. Nuclear Chemistry : -

(a) Discovery of radioactivity, The Curies, Radioactive decay and growth, Early characterization of the rays.

(Ref. 3, Page No. 1 to 7.)

(b) Composition of nuclei, Nuclear properties-Binding energy.

(Ref. 3, Page No. 19-25.)

(c) Types of radioactive decay-Alpha, Beta and Gamma decay.

(Ref. 2, Page No. 89 (4.2.1), P. 109 (4.6.1), P. 117 (4.7.1).)

(d) Measurement of radioactivity-Gaseous ion collection method, Proportional counters, G. M. Counter.

(Ref. 3, Page No. 243-245, 247-251.)

(e) Applications of radio isotopes-Typical applications of radioisotopes as tracers, Chemical Investigation-Reaction mechanism and structure determination, Age determination, Age of minerals and rocks, Age of earth.

(Ref. 2, Page No. 237-242, 260-265.)

Ref. 1—Principles of Physical Chemistry, 4th Edition,
By S. Maron and Prutton.

Ref. 2—Essentials of Nuclear Chemistry.
By Prof. H. J. Arnikar (Willey Eastern Ltd.)

Ref. 3—Nuclear and Radiochemistry, 3rd Edition,
By G. Friexlander and J. Kennedy.

Paper VI : Inorganic Chemistry

SECTION I

1. *Magnetic Properties of Chemical Substances :*

- (a) Importance of magnetism in transition element chemistry.
- (b) Explanation of the terms—Magnetic moment, magnetic susceptibility.
- (c) Types of magnetism—Paramagnetism, Diamagnetism, Ferromagnetism, Antiferromagnetism, Ferrimagnetism.
- (d) Curie Law, Curie—Weise law, Variation of magnetic susceptibility with temperature.
- (e) Use of magnetism in the determination of structure of complexes—Guoy method.
- (f) Spin only formula, Determination of number of unpaired electrons in a complex. (8)
(Ref. 1.)

2. *Co-ordination Chemistry :*

- (a) *General account*—Meaning of the terms such as co-ordinate bond, double salt, complex salt, chelate, complexation, central atom or ion, ligand, first and second co-ordination sphere, co-ordination number, charge on the complex ion, labile and inert complex. Nomenclature, Formation constant, Applications of complexes in different fields.
- (b) *Werner's theory*—Stereoisomerism with co-ordination number six and four, Simple types of isomerism such as ionisation, hydrate, linkage co-ordination, co-ordination position, ligand.
- (c) *Sidgwick model*—(effective atomic number), Limitation of sidgwick model.
- (d) *Valence bond theory*—Hybridisation and shape of complex, Structure and magnetic moment of complexes, Limitation of V. B. Theory. Inner and outer orbital complexes. Electroneutrality principle, Back bonding (multiple bonding in complexes.)

- (e) *Crystal field theory*—Shapes of d-orbitals, assumptions Splitting of d-orbitals in Oh, Td, sq. planer and tetragonal ligand, field strong field and weak field complexes (Ch and Td). C.F.S.E., Evidence of C.F.S.E. magnetic properties spectra, factors affecting magnitude of 10 Gd Jahn Teller distortion, Spectrochemical, series Effect of π bonding on complexes.
- (f) *M. O. Theory of octahedral complexes*—Charge transfer spectra, comparison of the theories. (32)
(Ref. 2.)

3. *Transition metal chemistry :*

Chemistry of Iron Cobalt and Nickel groups.

- (a) *Iron group*—Oxidation states general properties, Oxides Iron compounds, extraction.
- (b) *Cobalt group*—Oxidation states. general properties, compounds containing variable valency states such +1 +2. +3 and +4 states, occurrence and extraction.
- (c) *Nickel group*—Oxidation states, general properties, compounds containing valency states as -1, 0, +1, +2 only and extraction.
- (d) Horizontal comparisons in the Fe, Co, Ni groups. (8)
(Ref. 3.)

SECTION II

1. *Molecular orbital theory -*

- (a) Difference between atomic orbital and molecular orbital. Comparison of V. B. theory and M.O. theory.
- (b) L.C.A.O.—M.O. Principle. Formation of bonding, non-bonding and antibonding molecular orbitals.
- (c) Molecular orbital energy level diagram.
- (d) Molecular orbital electron configuration.
- (e) Homonuclear diatomic molecules of first row and second row elements.

- (f) Heteronuclear diatomic molecules—HCl, CO, NO.
 (g) Heteronuclear polyatomic molecules—NO₂, CO₂.
 (h) Multicenter bonding in electron deficient molecules. (12)
 (Ref. 4.)

2. *Chemistry of main group elements :*

Chemistry of group V (N...Bi) and VI (O.....Po).
 Position of the elements in periodic table, Electronic configuration
 of the elements, occurrence and isolation of the elements,
 Trends in properties of the elements with respect to the following
 points :

Sizes of atoms and ions, Ionisation potentials, Electronegativity,
 Oxidation states, and Reactivity.

Properties, bonding and shapes of oxides, halides and hydrides
 of these elements. (9)

(Ref. 3 and 4.)

3. *Lanthanides :*

Electron configurations, oxidation states, lanthanide contraction,
 occurrence, separation of lanthanides by ion exchange and
 solvent extraction methods, applications. (4)

(Ref. 1.)

4. *Actinides :*

Electron configurations, Oxidation states, General methods of
 preparation of transuranic elements, Nuclear fuels, Metallurgy of
 Curium. (4)

(Ref. 1.)

5. *Corrosion and passivity :*

Corrosion, Atmospheric and Immersed corrosion, Mechanism
 of corrosion (Theory of corrosion), Factors influencing
 corrosion. Factors pertaining to the metal, factors pertaining to
 the medium, factors pertaining to external influences, Protection
 of metals. Methods pertaining to metals, Methods pertaining to
 medium, Methods pertaining to external influences, Passivity of
 metals, Passivity theories, Electrochemical passivity. (9)

6. *Inorganic Polymers :*

Basic concept and definitions, classification of polymers, Organic and Inorganic polymers, comparative study.

Classification of Inorganic polymers, Homoatomic polymers such as polymers containing boron, silicon, phosphorus, sulphur, Fluorocarbons. Heteroatomic polymers such as silicons, phosphonitrite compounds, PON polymers, Borazole and its derivatives.

(6)

(Ref. 6.)

Reference Books :

N.B. :- Relevant pages from the following books are to be referred.

- (1) *Advanced Inorganic Chemistry*—Cotton and Wilkinson.
- (2) *Theoretical Inorganic Chemistry*—Day and Selbin, second Edn.
- (3) *Concise Inorganic Chemistry*—J. D. Lee, Second Edn.
- (4) *Basic Inorganic Chemistry*—Cotton and Wilkinson.
- (5) *Fundamental Concepts of Inorganic Chemistry*—Gilreath.
- (6) *Development in Inorganic polymer Chemistry*—Lappert and Leigh.

Paper VII : Organic Chemistry

SECTION I

1. *Structure, Reactivity and Organic Transformations (Revision)*
Acids and bases, Structural effects, Steric effects, Resonance effect, Resonance versus Tautomerism, Some consequences of resonance.

(3)

(Ref. 1, Chapter 6, Page No. 196-234.)

2. *Nucleophilic Substitution at saturated carbon :*
The reaction mechanism, Stereochemistry of nucleophilic substitution.

The variables in nucleophilic substitution.

(12)

(Ref. 1, Chapter 9, Page No. 369-392.)

3. *Elimination Reactions: Alkenes and Alkynes:*

The reaction mechanism, Stereochemistry, The direction of elimination. (9)

(Ref. 1, Chapter 10, Page No. 448-463.)

4. *Electrophilic Additions to Unsaturated Carbon:*

The mechanism of electrophilic addition, Direction and stereochemistry of addition to alkenes and alkynes, Hydrogenation, Ozonolysis. (10)

(Ref. 1, Chapter 11, Page No. 500-524, 530-534.)

5. *Substitutions at unsaturated Carbon-Aromatic Compounds:*

Aromaticity and structure of benzene, Mechanism and orientation in electrophilic aromatic substitution, Electrophilic aromatic substitution reactions-Hetero atoms as the electrophiles, Polycyclic aromatic compounds, Reactions of pyridines. (14)

(Ref. 1, Chapter 13, Page No. 596-602, 607-617, 624-642-665-671, 680-684.)

SECTION II

1. *Nucleophilic additions to the carbonyl group:*

Reactivity of the carbonyl group, Cyanide as the nucleophile-the cyanohydrin reactions, Hydride as the nucleophile-reduction, Carbon as the nucleophile-Organometallic compounds, Nitrogen as the nucleophile. (8)

(Ref. 1, Chapter 7, Page No. 240-249, 257-259, 264-282, 285 to 290.)

2. *Spectroscopy:*

Mass spectroscopy, Nuclear magnetic resonance, Infrared spectroscopy, Ultraviolet and visible spectroscopy, Spectroscopic solutions of structural problems. (20)

(Ref. 1, Chapter 5, Page No. 130-148, 158-195, Chapter 12, Page No. 583-589.)

3. *Colour and chemical constitution :*

Relation between colour and constitution, synthesis of :

- (i) Methyl Orange
- (ii) Phenolphthalein
- (iii) Congo-red
- (iv) Crystal Violet
- (v) Indigo
- (vi) Alizarin.

(4)

(Ref. 2, Volume 1, Chapter 31, Page No. 868-869.

Relevant pages for synthesis from chapter 31.)

4. *Natural Products :*

(a) Introduction to terpenoids and alkaloids, General methods of determining their structures.

(Ref. 3, Chapter 8, Page No. 354-358.

Chapter 14, Page No. 696-701.)

(b) Structure, Stereochemistry and synthesis of

- (i) Citral
- (ii) Menthol
- (iii) Alpha pinene
- (iv) Atropine
- (v) Ephedrine.

(10)

(Ref. 3, Chapter 8, Page No. 361-363, 379-382, 386-390.

Chapter 14, Page No. 703-705, 721-728.)

5. *Chemotherapy :*

Introduction, Classification of drugs based on their action.

Synthesis and uses of :

- (i) P-acetamol
- (ii) Sulphathiazole
- (iii) Isopropamide
- (iv) Benzocaine
- (v) Chloramphenicol
- (vi) Penicillin.

(1)

(6)

(Ref. 2, Chapter 18.)

Ref. 1, S. H. Pine, J. B. Hendrickson, D. J. Cram and G. S. Hammond, Organic Chemistry, 4th International Edition (McGraw Hill.)

Ref. 2, I. L. Finer, Organic Chemistry, Vol. 1, Sixth Edition (ELBS).

Ref. 3, Finer, Organic Chemistry, Vol. 2, Fifth Edition (ELBS).

Paper VIII : Analytical Chemistry

SECTION I

(A) Theoretical Basis of Quantitative Inorganic Analysis :

1. Acid base equilibria in water, strengths of acids and bases, Ionisation of polybasic acids. The ionic product of water. The hydrogen ion exponent, Buffer solution. (4)
(Page No. 7 to 11, 25, 26, 33 to 36.)
2. Equivalent weights, normal solutions, advantages of the use of equivalent system, preparation of standard solutions, Primary standard substances. (2)
(Page No. 40, 48 to 50)
3. Neutralisation indicators, preparation of indicator solutions, choice of indicators in neutralisation reactions. (4)
(Page No. 51 to 57, 70 to 72)
4. Electrode, potentials, concentration cells, calculation of the emf of a voltaic cell, oxidation reduction cell, calculation of the standard potential, change of the electrode potential during the titration of an oxident and a reductant, formal potentials; Detection of the end point in oxidation reduction titration. (6)
(Page No. 85 to 90, 94 to 103)
5. Common ion effect, solubility product, completeness of precipitation, Effect of acids, temperature and solvent upon the solubility of a precipitate, supersaturation and precipitate formation, the purity of the precipitate, conditions of precipitation, washing of the precipitate, ignition of the precipitate. (8)
(Page No. 12 to 17, 22, 23, 103 to 112, 114 to 119)

(B) Experimental technique of quantitative Inorganic analysis :

1. Balance weights and weighing, Description of a typical analytical balance, The requirement of a good balance care and use of the balance, methods of weighing, errors in weighing, calibration of weights. (8)
(Page No. 140 to 142, 144 to 156)

2. Volumetric apparatus, Volumetric flasks, Pipettes, Burette, Calibration of volumetric apparatus, Storage and preservation of solutions for volumetric analysis. (8)

(Page No. 193 to 206, 207, 208)

3. Precipitation, filtration, filter papers, filter pumps, Gooch crucible, Crucible fitted with permanent porous plates, Washing of precipitates, Drying and ignition of precipitates.

(Page No. 211 to 215, 218, to 222)

(C) *Errors in quantitative analysis :*

Accuracy, precision, mean deviation, standard deviation, classification of errors, minimization of errors, determination of the accuracy of methods of quantitative analysis. (4)

(Page No. 1121 to 1127)

SECTION II

(A) *Volumetric and gravimetric analysis :*

1. Preparation of a standard acid and alkali, determination of the sodium carbonate content of washing soda, determination of sulphuric acid in the concentrated acid, determination of a mixture of carbonate and hydroxide, determination of a mixture of carbonate and bicarbonate. (3)

(Page No. 233, 239, 246 to 248, 250, 251)

2. Preparation of AgNO_3 , standardisation of AgNO_3 solution, determination of chloride, bromide and iodide individually and in a mixture. (2)

(Page No. 258 to 263)

3. Preparation and standardisation of potassium permanganate and standardisation of determination of iron, calcium and hydrogen peroxide, preparation and standardisation of potassium dichromate, and standardisation of determination of iron, determination of iron in iron ore. (4)

(Page No. 282-284, 287-288, 294-295, 308, 309, 310)

4. Iodimetry, preparation and standardisation of sodium thiosulphate and iodine, determination of copper in copper sulphate, manganese dioxide in pyrolusite, determination of the available chlorine in bleaching powder. (6)

(Page No. 343-349, 354-56, 358, 360-361; 364)

5. Gravimetric analysis—determination of chloride as silver chloride, sulphate as barium sulphate, iron as ferric oxide, aluminium as aluminium oxide, calcium as oxalate, nickel as the dimethyl glyoximate. (6)

(Page No. 460-464, 468, 474, 479-480)

(B) *Instrumental methods of chemical analysis*

1. *Colorimetry*—General discussion, Lambert's law, Beer's law, Beer-Lambert law, Molar extension coefficient, application of Beer's law, Deviation from Beer's law, light filters, photoelectric colorimeters. Applications—determination of PH, determination of titanium, chromium and manganese. (6)

(Page No. 728-744, 755-760, 778, 779, 789, 792)

2. *Potentiometry*—Brief mention of electrode potential and various types of electrodes like hydrogen electrode, calomel electrode, silver-silver chloride electrode, quinhydrone electrode and glass electrode, Poggendorff compensation method, PH meters, potentiometric titrations : acid-base, oxidation reduction and precipitation. Applications—determination of the available chlorine in bleaching powder, determination of copper and chromium, determination of ferric iron with EDTA. (9)

(Page No. 921-934, 952-953 and 963)

3. *Conductometry*—Very brief mention of conductance, specific conductance, equivalent conductance and equivalent conductance at infinite dilution, conductivity cells, cell constant, conductivity bridge. Applications—conductometric titrations acid-base titrations of various types, displacement titrations, precipitation and complex formation titrations. (4)

(Page No. 969, 972-983)

4. *Polarography*—Polarograph, polarisation of electrodes voltage current characteristic of a micro electrode, supporting electrolyte, residual current, limiting current, diffusion current, Ilkovic equation polarographic maxima, half wave potentials, ancillary equipment for polarography, mercury, dropping mercury electrode, polarographic cells, maximum suppressors. Applications—determination of half wave potentials and concentrations of Cd, Zn and Mn ions in KCl solution. (1)

(Page No. 1000–1010, 1021–1028)

Reference :

1. A text Book of quantitative inorganic analysis including elementary instrumental analysis—A. I. Vogel, Fourth edition, The English Language Book Society.

Paper IX : Industrial Chemistry

SECTION I

1. *General Aspects of Industrial Chemistry :*

Chemical Industry, Economics of chemical processes, Chemical production—Raw materials, Unit processes, Unit processes, Unit operations, Quality control, Process control, Pollution control.

Chemical process technology—Classification of chemical reactions, Batch and continuous operations, Industrial chemical reactors, Conversion, Selectivity and yield. (3)

2. *Manufacture of Ammonia, Nitric acid, Phosphoric acid and Sulphuric acid :*

(a) *Manufacture of Ammonia*—Modified Haber-Bosch process, Raw materials, Process description with flowsheet, Physico-chemical principles involved, Synthetic ammonia systems, Economics.

(b) *Manufacture of Nitric Acid*—Ammonia oxidation method, Raw materials, Process description with flowsheet, Physico-Chemical principles involved, Concentration of nitric acid, Economics.

- (c) *Manufacture of Phosphoric acid*—(i) Wet process—Raw materials, Process description with flowsheet, Physico-chemical principles involved. (ii) Electric furnace process—Raw materials, Process description with flowsheet. (iii) Economic and comparison of wet and electric furnace processes.
- (d) *Manufacture of Sulphuric acid*—Contact process, Raw materials, Process description with flow sheet, Physico-Chemical principles involved, Economics. (8)

3. *Fertilizer Industry :*

- (a) *General*—Major components necessary in fertilizers, Classification of fertilizers, Classes of inorganic fertilizers, Types of fertilizers produced in India, Sources of raw materials required for manufacture of fertilizers in India, Acidity and basicity of nitrogen fertilizers.
- (b) *Manufacture of urea, ammonium nitrate, ammonium sulphate, superphosphate, triple superphosphate, ammonium phosphates, and nitrophosphates with reference to following points.*
 Chemical reactions, Flowsheet, Process description and Economics.
 Pollution and its control in fertilizer industry. (8)

4. *Electrochemical Industries :*

- (a) *Electroplating*—Purpose, General process, Plating equipment, Cleaning articles to be plated, Factors affecting the nature of electrodeposits, Chromium plating.
- (b) *Electrorefining of metals*—General principles, Electrorefining of copper.
- (c) *Electrometallurgy of zinc.*
- (d) *Electrolysis of alkali halides*—General principles, Electrolysis of sodium chloride by Castner cell and Nelson cell.
- (e) *Electrometallurgy from the electrolysis of fused electrolytes*—General principle, Electrometallurgy of aluminium. (8)

5. *Sugar Industry :*

(a) Sugar and brief summary of non-carbohydrate sweetening agents.

(b) Manufacture of cane sugar—(i) Cultivation and Harvesting of Sugar cane, (ii) Manufacture of raw cane sugar : Raw materials, Preliminary treatment to sugar canes, Extraction of juice by milling and by diffusion, Purification of juice by clarification or defecation process, Evaporation, Crystallisation of sucrose (caramellization, Sugar boiling, Masecutes) Centrifugation of masecutes (melasogenic effects of salt) Packaging, Flow sheet. (iii) Refining of raw sugar : Affination Melting, Purification, Filtration, Crystallisation, Drying, Screening, Packaging, Flowsheet. (iv) Manufacture of direct consumption (plantation-white) sugar. Flowsheet.

(c) Gur making and manufacture of Khandasari. Flowsheet.

(d) Manufacture of beet sugar Flow sheet.

(e) By products of sugar industry and their utilisation.

(f) Chemical control and analytical methods : Brix, Pole, Refractive index, Estimation of reducing sugars and their significance.

(g) Pollution and its control in sugar industry.

(h) Sugar industries in India.

(7)

6. *Fermentation Industry :*

Fermentation, Important products of industrial fermentations, Basic requirements of industrial fermentation process.

Industrial fermentation of alcohol from mollasses, Factors effecting production (yeast, starter, Nutrients, PH, Oxygen, Temperature, time, distillation etc.), Flow sheet, Variation in processing other raw materials like whey, Corn, Wheat, Sulphate liquor, Brewing beer, Wine, Spirits.

Pollution and its control in distillery.

(5)

7. Soaps and detergents :

(a) Soaps, Function of soap as a cleaning agent, Explain the terms—hydrophilic, hydrophobic, amphipathic, micelles, classification of soaps and their applications.

Raw materials for soaps—Fats and oil refining, alkalis and common salt, additives and filling materials. Soap manufacture :

(a) (i) Manufacture of neat soap by saponification of oils and fats, Processing of oils and fats, preparation of neat soap by full-boiled (kettle—process), Half, build and cold process. Flow sheet. (ii) Manufacture of neat soap from fatty acids. (b) Processing of neat soap to different soap products like toilet soap, laundry bar soap, laundry chip or flake soap, bead soap or soap powder. Flow sheet.

Specialty soap products—Transparent soaps, superfatted soaps, medicated or deodorant soaps, liquid soaps and shampoos, shaving soaps and creams, scouring soaps and cleaning powders, floating soaps.

By products of soap industry—Glycerine, fatty acids.

(b) Synthetic detergents (Syndets) vs soaps.

Explain the terms—Surfactants, Wetting action and wetting agents, emulsification and emulsifying agents.

Classification surfactants—Anionic, cationic, non ionic and ampholytic surfactants.

Syndet composition—Surfactants, detergent builders and additives, bleaching agents, Optical brightness, opacifying agents, Hydrotropes, soil redeposition preventing agents, enzymes.

Syndet products or formulations, Uses of syndets.

(c) Pollution and its control in soap and syndet industry.

Explain the terms—biosoft, biohard, eutrophication. (8)

SECTION II

1. Study of Following Unit Processes in Organic Synthesis :

A. Nitration and Industrial production nitrobenzene :

(a) Introduction.

(b) Nitrating agents.

- (c) Aromatic nitroion—Orientation, Theory of aromatic substitution, Ortho-para ratio.
- (d) Kinetics and mechanism of aromatic nitration.
- (e) Process equipment for technical nitrations, Types of process equipment, Batch nitration, Continuous nitration.
- (f) Industrial production of nitrobenzene—Batch nitration with mixed acid Separation and neutralisation }
Operating losses in nitrobenzene, Continuous nitration with fortified spent acid.

B. Amination by reduction and Industrial production of aniline

- (a) Introduction.
- (b) Methods of reduction.
- (c) Iron and acid reduction.
- (d) Reaction mechanism.
- (e) Chemical and Physical factors.
- (f) Equipment.
- (g) Manufacture of aniline. (18)

..... Industrial production of methanol.

2. Cement Industry :

- (a) Definition and classification.
- (b) Manufacture of portland cement—Raw materials, Preparation of kiln feeds by dry and wet process, beneficiation of raw materials by floatation, burning operation, treatment of clinker, storage of cement, economics of portland cement manufacture.
- (c) Cement industry in India. (6)

3. Glass Industry :

- (a) Glass. Crystal structure and glass structure, Glassy state.
- (b) Composition of glasses, Classification of glasses—silica glass, 96 percent silica glasses, Soda-lime-silica glasses, lead-alkali-silicate glasses, Boro-silicate glasses, Alumino-silicate glasses, Special glasses such as coloured glasses, Opal glasses, Fibrous glasses, Phosphate glasses, Silica free glasses, Opague glass.

- (c) Properties of different types of glasses—Viscosity, thermal expansion, thermal endurance, thermal conductivity, optical properties, electrical properties, mechanical strength, chemical durability.
- (d) Manufacture of glass—Raw materials and functions of glass forming oxides. Outline of manufacture of glass, Glass melting, Glass formation by hand molding and mechanised processes like pressing, blowing, drawing, rolling, Annealing and finishing.
- (e) Glass ceramic materials—Nature and formation, properties and applications.
- (f) Applications of glasses in different fields—Chemical, lighting and light filters, electrical, optical, thermal, structural etc. (12)

4. Ceramic Industry :

- (a) Definition, classification, classes of refractory materials.
- (b) Elementary treatment of bonding in solids.
- (c) Basic raw materials for ceramic preparations, ceramic industry, ceramic process, outline of process of manufacture of ceramic materials. Manufacture process commonly used in ceramic materials—Material and body preparation, Forming processes (Dry pressing, extrusion, forming from soft plastic masses, slip casting), Green finishing, Drying of ceramic ware, Firing of ceramic ware, Glaze, Enamels, Ceramic colours.
- (d) Ceramic products—Traditional ceramics (Whitewares, structural clay products, refractories enamels and enameled metal). New ceramics. Metal ceramic and other composites.

Reference Books :

1. Principles of Industrial Chemistry—C. A. Clausen and G. Mattson, Wiley Interscience.
2. Rogers' Industrial Chemistry, Vol. I and II—Furnas, Ed. D. Van Nostrand Company.

3. 'Chemical Process Industries'—Norris Shreve, Mc-Graw-Hill Book Company.
4. Riegel's Handbook of Inorganic Chemistry—James A. Kent, Van Nostrand Reinhold Company.
5. Dryden's outlines of chemical technology—M. Gopala Rao and Marshall Sittig.
6. Chemical Technology—George Koval, Translated by (Original Authors): Mulkhyonov and others), MIR Publishers, Mosco.
7. Init process in Organic Synthesis—P. H. Groggins.
8. 'Industrial Chemistry' Parts I and II—R. K. Das
9. Elements of Ceramics—Nortin, Addit'ion—Wesley Publishing Company.

Paper X A (Optional) :

Petrochemicals and Polymers

SECTION I

Petrochemicals :

1. Petroleum and its products (Ref. 3, 403-426) (L-6)
Discovery of petroleum, petroleum reserves, nature of petroleum, classification of petroleum, petroleum refining, desalting, distillation. Cracking processes such as thermal and catalytic cracking. Catalytic reforming, ultraforming. Lubricating oil, refining)
hydrogen processing of petroleum.

2. The sources of petroleum hydrocarbons (Ref. 1, 17-41) -
(L-4) Composition of crude petroleum, natural gas, separation of crude petroleum, paraffin wax. Other refinery processes such as thermal cracking, catalytic and hydrocracking, thermal reforming, catalytic reforming, hydrogen treating, alkylation. Isomerization and polymerization.

3. Manufacture of olefins (Ref. 1, 97-129; Ref. 2, 1-17)
(L-8) Principles of cracking and pyrolysis, cracking practice,

separation of gases. Individual olefins—ethylene, propylene, butenes. Thermal cracking for olefins.

4. Hydration of olefins (Ref. 1, 136-145) (L-2)

Absorption in sulfuric acid, catalytic hydration, ethyl alcohol.

5. Oxidation of olefins (Ref. 2, 61-70) (L-4)

The production of acetic acid, ethylene oxide, propylene oxide.

6. Diolefins (Ref. 2, 18-39) (L-4)

7. The production of butadiene.

7. Naphthenes (Ref. 1, 245-259) (Ref. 2, 126-137) (L-5)

Routes to naphthenes, occurrence, isolation and reactions, naphthenes, the manufacture of caprolactam.

8. Aromatics (Ref. 1, 260-298; Ref. 2, 99-125) (L-10)

Benzene, toluene and xylenes, higher aromatics, naphthalene. Manufacture of styrene and routes to phenols.

9. Acetylenes (Ref. 2, 40-49) (L-2)

The BASF acetylene process.

10. Petroleum deposits in India; Detection of petroleum deposits; status of petroleum industry. (3)

Reference :

1. The petroleum chemicals industry, 3rd Edition, R. F. Goldstein and A. L. Waddams, E. and F. N. Spon (1967).
2. Production of polymers and plastic Intermediates from petroleum, R. Long, Butterworths (1967).
3. Riegel's Handbook of Industrial Chemistry, 7th Edition, J. A. Kent, Van Nostrand (1974).

SECTION II

Polymer Chemistry :

1. Introduction : Polymers Polymer based industries—rubber plastics fibres coatings, adhesives. (6)

(Ref. 1, Chapter 1)

2. Polymer formation : Polymerization reactions, functionality kinetic schemes, chain polymerization, stepwise polymerization ionic and coordination complex polymerizations. (detailed mechanism and rate expressions to be omitted by the student)

(Ref. 1, Chapter 4.)

3. Polymerization processes : Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization. (6)

(Ref. 1, Chapter 5.)

4. Molecular weight of polymers : Average molecular weight, measurement of molecular weight, number average, molecular weight methods, weight average, molecular weight methods. (6)

(Ref. 1 Chapter 6.)

5. Carbon chain polymers : Polyethylene, ABS group diene polymers Vinyls acrylics fluorocarbons (Detailed manufacturing process and flow sheets to be omitted.) (10)

(Ref. 1 Chapter 13.)

6. Hetero chain polymers : Polyester, Polyethers. Polyaccharides, polyamides, aldehyde condensation polymers, polyisocyanates (Detailed manufacturing process and flow sheet to be omitted.

(Ref. 1, Chapter 14.)

Reference :

1. Principles of polymer systems. F. Rodrigues. Tata McGraw Hill Publishing Company Ltd., New Delhi.

Paper X B (Optional) :

Nuclear and Environmental Chemistry :

SECTION I

Nuclear Chemistry :

1. The atomic nucleus : The nucleus and the outer sphere, classification of nuclides, nuclear stability. (4)

(Page 3-13)

2. Nuclear models : The shell model, the liquid drop model, the semi empirical mass equation. (6)

(Page 52-57 67-73.)

3. Radio activity : Types of radio active decay and decay schemes general characteristics, decay kinetics, alpha decay, beta decay, gamma emission, nuclear isomerism and isomeric transition, internal conversion, the augur effect. (10)

(Page 89-95, 109-111, 117-124, 137-143.)

4. Nuclear reactions : Bethe's notation, types of nuclear reactions. (4)

(Page 148-151.)

5. Nuclear fission : The process of nuclear fission, fission fragments, mass and charge distribution, fission energy, nuclear reactors, breeder reactor, nuclear reactivity in India. (8)

(Page 186-193, 209-211, 222-224.)

Nuclear reactors—The natural uranium reactor, the classification of reactors, typical reactors, breeder reactor, nuclear reactor in India. (4)

(Page 209-211, 216-219, 222-224.)

Applications of radio activity probing by isotopes, typical reactions for the preparation of radio isotopes, the Szilard-Chalmers reaction, radio chemical principles, typical applications of radio isotopes as tracers, analytical applications, age determinations, medical applications, agricultural applications, industrial applications. (16)

Reference :

Essentials of Nuclear Chemistry, H. J. Amikar, Wiley Eastern Limited, New Delhi (1982).

SECTION II

Environmental Chemistry :

1. Brief discussion of chemical evolution and origin of life (Ref. 1, Page 40-60, highlights.) (2)

2. Brief discussion of fossil fuels and newly developing energy sources. (Ref. 1, Page 92-155, highlights.) (4)

3. Air and air pollution (Ref. 1, Page 181-253; Ref. 2, Page 7-29 and 67-71.) (14)

- (a) The atmosphere—Structure and properties, temperature inversion and air pollution episodes, atmospheric photochemistry, possible depletion of stratospheric oxygen, natural versus polluted air.
- (b) Air pollution—Industry and energy related. Particulate matter, analysis and control of particulates, sulfur oxides, effect of sulfur dioxides and particulates, control technology for sulfur oxides, other industrial air pollutants.
- (c) Air pollution—Transport related. Carbon monoxide, nitrogen oxides, photochemical smog airborne lead, control of automobile emissions, alternatives to the auto cycle engine.
- (d) Miscellaneous : Aerosols—Carbon dioxide and water, indoor pollution

4. Water and water pollution. (Ref. 1, Page 351-412.) (14)

- (a) General principles—Unique physical and chemical properties criteria of water quality, natural water—eutrophication, detergents and phosphates.
- (b) Municipal waste water treatment—The importance of microorganisms in water purification, primary and secondary treatment, tertiary or advanced waste water treatment, removal of nitrogen and phosphorous, disposal of treated waste water in solids.
- (c) Industrial waste water—Sources of industrial water pollution, heavy metals, mercury, detection and abatement of mercury pollution, paper mills, abatement of paper mill pollution.

5. Solid wastes. (Ref. 1, Page 317-345.) (4)

Population, affluence and technology, municipal wastes, reclamation, recycling and reuse. The entropy ethic and solid waste.

6. Life. (Ref. 1, Page 417-470.) (10)

(a) Toxic substances. Lipids, detoxification of foreign substances enzyme activation and inhibition, molecular mechanisms of mutagenesis, carcinogenesis and tetrato-genesis classification of toxic substances. The vinyl chloride episode. Control of toxic substance in the environment.

(b) The sustenance of life. Food quality, the green revolution, pest control, persistence of pesticides, toxicity of pesticides, mode of action of pesticides, integrated pest management, energy and agriculture.

References :

- (1) Environmental Chemistry J. W. Moore and E. A. Moore, Academic Press, New York (1976).
- (2) Air pollution, D. J. Spedding, Clarendon Press, Oxford (1974).

General Reference :

Chemistry and Pollution, F. R. Benn and C. A. Moauliffe, McMillan (1975).

Paper X.C (Optional) :

Fundamentals of Biochemistry and Molecular Biology and Drugs and Pharmaceuticals.

SECTION I

Fundamentals of Biochemistry and Molecular Biology :

1. Enzymes. (Chap. 7, 157-160, 168-180, 184-188.) (6)
2. Biochemical energetics. (Chap. 6, 137-138, 141-152.) (3)
3. Metabolism of Carbohydrates, Fats, Aminoacids.
(Chap. 10, 279-294, 304-307, 327-336.)
(Chap. 13, 353-357, 359-360, 363-368.)
(Chap. 17, 462-470.) (10)
4. Vitamins and co-enzymes. (Chap. 8, 195-197.) (5)
Structure and Biochemical functions of nicotinamide, Riboflavin, Lipoic acid, Biotin, Thiamine, Pyridoxine, Folic acid.
(Relevant Pages from Chap. 8, pp. 198-222.)

5. Nucleic acids. (Chap. 5, pp. 111-119, 124-132.) (4)
 6. Biosynthesis of Nucleic acid.
 (Chap. 13, 505-526.)
 7. Biosynthesis of proteins. (Chap. 19, 527-555.) } (20)

Reference

Outlines of Biochemistry—By E. E. Conn and P. R. Stumpf,
 4th edition, Wiley International (1976).

SECTION II

Drugs and Pharmaceuticals :

1. General aspects of medicinal agents, Mechanism of action (Bioavailability), Drug assimilation, distribution and elimination.
 Ref. 1, Chapters 1, 2, 3 and 4, pp. 11-87.

Doses—Toxicity of drugs, Drug interaction.

Drug abuse—Alcoholism, Psychomimetic agents and self medication.

Ref. 2, Chapter 68, pp. 1268-1800.

Systemic Drugs :

A. Drug acting on G.I.T. (Gastro Intestinal Tract)—
 general introduction, examples and structures of Antacids, Laxatives, Purgatives, Antiulcers, Antispasmodics, Carminatives.

Ref. 2, Chapter 40. Page No. 734-756.

B. Drugs acting on CNS (Central Nervous System)—
 Introduction, examples and structures, uses of Analgesics, Antipyretics, Tranquillisers and CNS stimulants.

Ref. 3, Chapters 3½, 8, 9, 3 (8-14), 8 and 9 (32-45.)

C. Drugs acting on ANS (Autonomous Nervous System)—
 Cholinergic and Adrenergic agents, Anticholinergic, Alpha and Beta blockers.

Ref. 3, Chapters 15, 16. (353-392).

D. Drug acting on cardiovascular system—Cardiotonic—
 Cardial glycosides, Antihypertensive and Anticoagulants.

Ref. 1, Chapters 17, 18. (17 (396-426), 18 (432-442).) (20)

3. *Chemotherapy*—Study of different agents, Mechanism of action, Structures and uses of—

- | | |
|-------------------|-------------------------|
| (1) Antimaterials | (2) Antibacterials |
| (3) Antiamoebic | (4) Antifungal |
| (5) Antiviral | (6) Anticancer |
| (7) Antibiotics | (8) Sulphonamides. (18) |

*Ref. 1, Chapters 28, 30, 32, 33, 34, 36, 37. OR

Ref. 3, Chapters 26 to 30, 33, 34, 35. 26 to 30 (148-187), 33 to 35 (196-204.)

References

1. Principles of Medicinal Chemistry—William O. Foye.
2. Remington's Pharmaceutical Science. (MACK Publishing Company, Easton, Pennsylvania.)
3. Organic Pharmaceutical Chemistry—Harkinsan Singh and V. K. Kapoor.

Note :—*28 (Pages 705 to 710), 32 to 34 (Pages 755-816), 36 and 37 (Pages 837-870.)

Paper X.D (Optional) :

Introduction to Biochemistry and Molecular Biology :

SECTION I

Biomolecules: Structure and functional groups. Stereoisomerism and optical activity. Biochemical activity and physiological significance.

- (a) Amino acids, peptides and their amphoteric properties, colour reactions of amino acids.
- (b) Bases, nucleosides and nucleotides, coenzymes.
- (c) Sugars (aldoses and ketoses) mono-, di-, tri- and oligosaccharides.
- (d) Lipids, simple lipids, phospholipids and glycolipids. (10)

Biopolymers : Primary, secondary, tertiary and quaternary structures.

- (a) **Proteins :** Globular proteins—structure and function of myoglobin and hemoglobin. Fibrous proteins.
- (b) **Enzymes :** Biocatalysts—structure and function. Kinetics of enzyme catalysed single substrate irreversible reactions. Determination of K_m , V_{max} and their significance. Simple competitive and non-competitive type of inhibition. Determination of K_i . Simple problems on enzyme kinetics.
- (c) **Nucleic Acids :** Structure of DNA and RNA (t-, m-, r-).
- (d) **Polysaccharides :** Starch, Glycogen and Cellulose. Structural features of biomembranes—active and passive transport of ions and metabolites across the plasma membrane. (15)

Cell : Structure of cell and intracellular organization. Comparative study of structure of bacterial, animal and plant cells as observed under light microscope and electron microscope. Chemical basis of microscopic staining. (6)

Cell obey the laws of chemistry. Laws of thermodynamics, concept of free energy and their application to biologic systems. (Watson—Chapters 2-6, pp. 25-146), Origin of life and the Mendelian view of world. (1)

Separation methods used in biochemical investigations :
Principle and applications :

- (a) Electrophoresis.
- (b) Centrifugation and Ultracentrifugation.
- (c) Chromatography (adsorption, ionexchange, partition, gel filtration and bioaffinity).
- (d) Dialysis and ultrafiltration.
- (e) Fractionation of proteins with ammonium sulphate and water miscible organic solvents. (7)

SECTION II

Bioenergetics and Metabolic Pathways—With emphasis on mechanism of reactions. Lehninger—Part II (pp. 331–645). (21)

Some aspects of Human Biochemistry, Digestion, Transport, and the integration of metabolism. Hormones and vitamins. Human nutrition, with special reference to Indian food preparations
 (1) their nutritive value. Food additives, preservation and poisons. Lehninger—Part III (pp. 681–735.) (6)

The arrangement of genes on chromosomes—structure and function. Genetic code and mutation. Molecular basis of replication, transcription and translation processes. Structure of viruses and their replication. Lehninger—Part IV (P. 791–913), Watson (P. 149–685)—general outline of molecular biology. (21)

Text Books

- (1) Principles of Biochemistry—A. L. Lehninger, 1st Edition, CBS—Publication and Distributors, Delhi-110032 (1984).
- (2) Molecular Biology of the Gene—J. D. Watson, 3rd Edition, W. A. Benjamin, INC, California, USA.

Paper X : Optional—Agriculture and Dairy Chemistry :

SECTION I

A. Agriculture Chemistry :

Fertilizers :—Importance of fertilizers of classification of fertilizers in crop production. Chemical principles involved in manufacture of N.P.K. fertilizers, Physico-Chemical properties of nitrogen ions, phosphatic fertilizers Reaction of N.P.K. fertilizers in calcareous and acid soils. Fertilizers containing micro-nutrients. Mod of application of fertilizers. Factors affecting efficacy of fertilizers. Slow releasing fertilizers, trification inhibitors. Problem associated with storage of fertilizers. (7)

Manures :—Farm yard manure, oil cake, green manures agroindustrial and urban waster organic recycling role of manures in soil fertility, biogas plant survey, sewage. (3)

Soil Testing and Fertilizer use :—Sampling of soils. Testing of soil sample for texture, PH, conductivity, organic carbon available N.P.K. Test for lime and Gypsum requirements of problem soils interpretation of soil, test results for fertilizer recommendation. Soil fertility and factors affecting it, Evaluation of soil fertility. Soil, water it's expression, energy concepts, soil moisture constants. Testing irrigation water for PH, CO_3 , HCO_3 , Cl, SO_4 , Mg, NO_3 , interpretation of results. (2)

Pesticides :—Classification, structure and chemical properties of pesticide. (2)

Fungicides :—Copper, Sulphur and mercury compounds, antibiotics, bacteriocides. (2)

Herbicides :—Systemics, selectives and nonselective weed killers, Rodenticides, nematocides, Hormones, growth modifiers cycocoeil, Gibberilina, formulation of chemicals, compatibility of sprays Hazards and safety measures, safe limit of chemical residues in food and vegetable. (2)

Insecticides :—Synthetic and plant originated compounds, organic organ phosphates, organo chlorinated hydrocarbons carbonates, fluorides, arsenates, pyrethrum and rotenone. (2)

B. Practicals :

(Each practical is of three hours. Out of 10 at least 8 practicals are to be taken.)

1. Analysis of B.H.C.
2. Analysis of Copper Fungicides.
3. Determination of pesticide residues in food grains and vegetables.
4. Analysis of fertilizers for moisture, Nitrogen Phosphorous and K.
5. Analysis for PH, organic carbon available N.P.K. in fertilizer mixtures.
6. Collection of representative soil samples from fields and preparation of soil sample in laboratory.
7. Analysis for free CaCO_3 , Lime and Gypsum requirements of problem soils.

8. Analysis of irrigation water and interpretation of results.
9. Preparation of soil test report interpretation of results and fertilizer recommendations.

Reference Books for Section I

- (1) Agricultural problems of India by P. C. Bansil.
- (2) Agricultural problems of India by C. B. Mamoria.
- (3) Indian Rural Economy by N. C. Joshi.
- (4) Agricultural development of Indian Policy and problems edited by C. H. Shah and C. N. Vakil.
- (5) Hand book of Manures and fertilizers I.C.A.R. Publications.
- (6) Manures and fertilizers by Yavalkar.
- (7) Soil conservation in India by M.S.V. Ramarao, Publisher-Indian Council of Agricultural Research, New Delhi.
- (8) Elements of soil conservation by H. H. Bennett, Publisher-Mc Graw H.H. Book Company, New York.
- (9) Introduction to Dyronomy and soil water management by Vaidya and Sahasrabudde.
- (10) Soil management in India by Arakori et al.

Equipment for Practicals for Section II :

- Expt. 1 :—Burette 50 ml., Pipette 25 ml., Conical flask 250 ml.
 Expt. 2 :—Burette 50 ml., Pipette 25 ml.
 Expt. 3 :—Burettes, Pipettes, Conical flask.
 Expt. 4 :—Kjeld's flask, Burette, Pipette etc.
 Expt. 5 :—PH meter, Flame photometer.
 Expt. 6 :—Burettes, Pipettes, Conical flask etc.
 Expt. 7 :—Burettes, Pipettes, Conical flask etc.
 Expt. 8 :—Emil's Colorimeter.
 Expt. 9 :—Burettes, Pipettes, Conductometer.
 Expt. 10 :—Semimicro apparatus.

SECTION II

A. Dairy Chemistry (Theory) :

1. *Introduction* :—Importance of dairy Chemistry, Different constituents of milk, proteins, Lipids, minerals, enzymes vitamins, constituents of milk as affected by milk process. (4)

2. *Composition of Milk* :—Composition of milk from different species e.g. cow, sheep, goat, buffalo milk, Factors affecting the composition of milk. (4)

3. *Proteins* :—Study of major milk proteins and whey proteins Protein classification and nomenclature. (4)

4. *Milk Products* :—Different major milk products. Nutritive value of milk and milk products. (4)

5. *Harmones and other Classes of Compounds* :—Study of hormones, Carbohydrates, minerals, Lipids, enzymes, in relation to milk. Biosynthesis of milk. (8)

B. Dairy Chemistry (Practicals) :

(Each practical is of three hours. Out of ten at least eight practicals are to be conducted.)

1. Determination of specific gravity of milk from different sources by using lactometer and specific gravity bottle.

2. Determination of fat content in milk and milk products like cream butter.

3. Determination of total calcium and phosphorous.

4. Determination of case in milk.

5. Determination of refractive index of ghee.

6. Determination saponification value and iodine value.

7. Estimation of acidity of milk and milk products.

8. Determination of adulterants and preservative in milk.

9. Determination of PH and total solids in different milks.

10. Sampling of milk and microscopic examination milk.

Reference Books for Section II

(1) Outline of dairy technology by Sukumar Deo.

(2) Milk and milk product by Damphart.

(3) Testing of milk and milk products by Atherton and Newlands A.V.T. Publications.

(4) Fundamental of dairy science by Webb and Jonson.

Note :—Equal weightage is given to theory and practicals of respective sections (i.e. 50 marks for theory and 50 marks for practicals.) End examination will be conducted similar to component 'C' of restructuring course.

T.Y.B.Sc. (Chemistry) :

Physical Chemistry Practicals :

Group A (Compulsory) :

1. Kinetics of hydrolysis of an ester (Two concentrations).
2. Comparison of relative strengths of HCl and H_2SO_4
the kinetics of inversion of cane sugar.
3. Kinetics of the decomposition of H_2O_2 by oxygen liberation, method catalysed by KI.
4. Determination of the molar refraction of given compounds-acetone, benzene, chloroform and carbon tetrachloride.
(Densities to be determined by pycnometer.)
5. (a) Determination of λ/\max and concentration of given copper sulphate in ammonia solution by colorimetry.
(b) and λ/\max and concentration of $K_2Cr_2O_7$ in 0.01 N NaOH.
6. Determination of the transition temperature of sodium sulphate decahydrate/Sodium acetate decahydrate by (a) thermometric method and (b) dilatometric method.
7. (a) Determination of the cell constant of a given conductivity cell using 0.01 N KCl.
(b) Determination of the dissociation constant of a weak monobasic acid.
8. (a) Preparation of 4 different buffers and checking their PH potentiometrically. Determination of the PH of given solution.
(b) Determination of the pka value of a given weak acid (formic/acetic/propionic) potentiometrically.
9. (a) Determination of plateau voltage of GM counter and its resolution time.
(b) Determination of Enax.
10. Critical solution temperature for phenol-water system and effect of addition of salt on the critical solution temperature.

Group B (Select any 10 Experiments) :

1. Determine stability constant of I_3^- by distribution method.
2. Determine molecular weight of a high polymer by viscosity method.
3. Determination of the approximate size of oleic acid and calculate Avogadro number.
4. Determination of specific refractivities of the given pure liquids A and B and determination of the percentage composition of given mixture of A and B.
5. Estimation of amount of NaCl in a given solution by potentiometric titration.
6. Determination of degree of hydrolyses of aniline hydrochloride by PH meter.
7. Determination of energy of activation of a reaction between $K_2S_2O_8$ and KI.
8. Study of the kinetics of iodination of acetone, Catalysed by acid by iodometry.
9. Determination of molecular weight of benzene or toluene or carbon tetra chloride by steam distillation.
10. Determination of formal redox potential of Ferrous/Ferric system potentiometrically.
11. Colorimetric determination of $Cr_2O_7^{2-}$ and Mn^{2+} simultaneously in a given mixture in dilute sulphuric acid medium.
12. Estimation of lead in lead nitrate by conductometric titration with sodium sulphate.
13. Comparison of the relative strengths of HCl and H_2SO_4 by measuring the rates of hydrolysis of an ester.
14. Determination of pka value of a given weak acid by PH metric titration with strong base.
15. Comparison of catalytic effects of formate and acetate ions in iodination of aniline.

References

1. Experiments in General Chemistry by C. N. R. Rao and U. C. Agrawala.
2. Practical Physical Chemistry by A. Findlay.
3. Laboratory manual of Physical Chemistry by W. J. Popiel.
4. A text-book of quantitative inorganic analysis by A. I. Vogel, Third Edn.

B.Sc. (Chemistry)

Inorganic Chemistry Practicals :

Group A (Compulsory-10 Sessions)

1. Qualitative analysis of two cations and two anions together from a mixture of powders including phosphates and borates. (At least 6 mixtures should be analysed.)
2. Gravimetric estimation of
 - (a) Pb as $PbCrO_4$
 - (b) Ni as Ni (DMG) Complex.
3. Volumetric estimation of (any two) :
 - (a) Chloride by Volhard method.
 - (b) Mn by Volhard method.
 - (c) Mg by disodium EDTA including as standardisation.

Group B (Total 10 Sessions)

(I) Following 5 sessions are compulsory :

1. Colorimetric estimation of (any two) :
 - (a) Chromium (by diphenyl carbazide)
 - (b) Titanium (by H_2O_2)
 - (c) Cobalt (by R-Nitrososalt).
2. Detection of cations from a binary mixture by paper chromatography (at least two mixtures should be analysed). (Cations for study- Cu^{2+} , Al^{3+} , Fe^{2+} , Ni^{2+} , Co^{2+} , Mn^{2+} , Zn^{2+}).
3. Volumetric estimation of iron from portland cement using standard solution of $K_2Cr_2O_7$ by both the internal and external indicator techniques.

(II) Any 5 sessions from the following :

1. Qualitative analysis of a mixture containing two cations by spot tests (at least 2 mixtures should be analysed) (Cations for study— Fe^{3+} , Mn^{3+} , Co^{2+} , Ni^{2+} , Sn^{2+} , Sb^{3+} , Hg^{2+} , Cu^{2+}).

2. Estimation of antimony in type metal (alloy) by permanganate method.

3. Estimation of tin and lead in solder (alloy) using disodium EDTA.

4. Determination of Phosphorus as P_2O_5 in phosphatic fertilizer sample.

5. Determination of hardness of water.

6. Volumetric estimation of titanium using 8-quinolinol and potassium bromate.

7. Preparation of Reineck's salt.

8. Preparation of tris ethylene diamone Ni(II) thio-sulphate.

9. Colorimetric estimation of :

(a) Iron from haemoglobin in given sample of blood

(b) Inorganic phosphate in blood by Fiske and Subba Row, method. If possible visit to a Chemical Plant or industry may be.

T.Y.B.S.c. (Chemistry)

Organic Chemistry Practicals :

Group A (Compulsory)—(Ten Sessions)

(1) Preparation of derivatives (Any two) :

(a) Acetyl.

(b) 2, 4-Dinitro, phenyl hydrazone.

(c) Semicarbazone.

(2)

2. Techniques of Organic Chemistry :

(a) Thin layer chromatography.

(1)

3. *Single stage preparation (any two) :*

- (a) Nitroation (Benzene to m-di-nitro benzene).
- (b) Bromination (Aniline to tribromo-aniline).
- (c) Oxidation (Hydroquinone to quinone).
- (d) Sand meyer reaction (Anthranilic acid to o-chloro benzoic acid).
- (e) Acetylation (Salicylic acid to aspirin.)
- (f) Hydrolysis (Methyl benzoate to benzoic acid). (2)

4. Separation of mixtures (two components), five mixtures to be analysed. (5)

Group B (10 Sessions)1. *Estimations (Any five) :*

- (a) Of amide by hydrolysis.
- (b) Of ester by hydrolysis.
- (c) Of glucose by hypiodite method.
- (d) Components in APC tablets.
- (e) Of sulpho drugs.
- (f) Of protein by biuret.
- (g) Of urea by urease method. (5)

2. Column chromatography. (1)

3. *Synthesis of commercially valuable chemicals (any two) :*

- (a) Aspirin.
- (b) Paracetamol.
- (c) Methyl salicylate.
- (d) Phenolphthalein.
- (e) Methyl orange.
- (f) Polystyrene. (2)

4. *Natural Products* (Any four—equivalent to 2 sessions) :

- (a) Saponification value of an oil.
- (b) Isolation and estimation of starch in potato.
- (c) Preparation of caffeine from tea leaves.
- (d) Detection and estimation of unsaturation in oils.
- (e) Detection of anthocyanins from plants (by TLC).
- (f) Estimation of vitamin C.
- (g) Isolation of lipids from ground nut oil and characterisation (by TLC).

(4)

Printed at : The Poona University Press, Ganeshkhind, Pune-7;

Printed and Published by : Shri V. S. Pol, Registrar,

University of Poona, Ganeshkhind, Pune-7.

500—1—89 (1632)