UNIVERSITY OF CALICUT

(Abstract)

Implementation of revised scheme and Syllabus of M.Sc Chemistry with effect from 1998 admission onwards - approved - orders issued.

G&A I J SECTION

GA I/JI/2198/96. Dated, Calicut University P.O. 21-10-1997.

Read:-
1. Minutes of meeting of Board of Studies in Chemistry (PG) held on 4.6.1997 and 5.6.1997.
2. Minutes of meeting of Faculty of Science held on 3.7.1997.
3. Minutes of meeting of Academic Council held on 31.7.1997.

ORDER

1) The Board of Studies in Chemistry (PG) at its meetings held on 4.6.1997 and 5.6.1997 resolved to finalise the revised Scheme and Syllabus of M.Sc Chemistry. All the theory and practical papers have been modified to include a project work to be carried out during the entire Course.

2) The Faculty of Science at its meeting held on 3.7.1997 endorsed the recommentations of Board of Studies.

3) The Academic Council at its meeting held on 31.7.1997 approved the minutes of Board of Studies and Faculty of Science.

Sanction is therefore, accorded for the implementation of revised scheme and Syllabus of M.Sc Chemistry Course with effect from 1998 admission onwards.

The revised scheme and Syllabus is appended.

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offering M.Sc Chemistry Course.

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SECTION OFFICER.

PT.23/10/

The Head of the Department shall communicate the Title and the area of the specialization of the project to the Controller of Examination by 31st March ~~1997~~ of final year for onward transmission to the Chairman, Board of Examinations. The Chairman will assign the evaluation work to the respective examiners (double valuation). The dissertations shall be made available to the respective examiners during the practical examination. The examiners shall evaluate the project work on a seperate day after the practical examination. The copies of dissertation after valuation shall be returned to the Head of the Department on the day of the Viva-Voce examination. The Viva-Voce will be conducted on a seperate day . Pass minimum for the project is 50% of the total marks. A candidate who gets less than 50% in the project shall resubmit the Dissertation within three months after incorporating the modification suggested by the examiners.

7. Seminar

Each student shall conduct at least one seminar on a suitable topic. Performance in the seminar is to be answered internally and marks should be communicated to Controller of Examinations before 31st March of the second year from the College/Department.

PAPER I - THEORETICAL CHEMISTRY (66 L)

Unit T - 401 Quantum Chemistry (27 L)

a) Basic ideas (3 L)

Particle character of radiation. Wave character of Particles. Matter waves. Electron diffraction. The uncertainty principle.

b) Postulates of quantum mechanics (6 L)

Complex function, complex conjugete. Modulus of a complex function. Operators. Eigen functions and eign values of an operater, Linear and Hermitian operaters. Postulates: State function, observables and corresponding operators. Hamiltonian operator. Eigen values and expectation values. Time dependent Schrodinger equation. Stationary states and time independent Schrodinger equation.

c) Application of the Schrodinger equation to a few simple Systems (6 L)

The Particle in a one-dimensional box: Eigen functions and eigen values. The particle in a three-dimensional box: Degeneracy.

The one-dimensional harmonic oscillator. The Hermite polynomials. The three dimensional harmonic oscillator. The rigid rotator. Transformation to spherical polar coordinates. Analogy to the particle on a ring and the particle on a sphere problems. Legendre polynomials, Associated Legendre polynomi als and functions, Spherical harmonics, Angular momentum operators and their expectation values.

d) Hydrogen-like atoms (3 L)

The wave equation in spherical polar coordinates and separation of variables. Solution of their, equation; Laguerre Polynomials. Associated Laguerre polynomials.

Contd...2.

List of wave functions. Discussion of the wave functions. Orbital diagrams and their significance.

e) Approximation methods (3 L)

The perturbation method. Simple applications: Zeeman effect in hydrogen like atoms. Ground state of the helium atom. The variation method. Simple applications: Stark effect in hydrogen like atom. Ground state of the helium atom.

f) Electron spin (3 L)

Spin functions and operators. Coupling of orbital and spin functions. Slater determinants. Pauli's exclusion principle. Spectroscopic term symbols for atoms.

g) Complex atoms (3 L)

Slater's treatment of complex atoms. The self-consistent field method. Hartree-Fock method (brief discussion).

References:

1. I N Levine, Quantum Chemistry, Printice Hall
2. F L Pilar, Elementary Quantum Chemistry McGraw-Hill.
3. A K Chandra Introduction to Quantum Mechanics Tata-Mcgraw-Hill
4. Strauss Quantum Mechanics Prentice-Hall.
5. M W Hanna, Quantum Mechanics in Chemistry W A Benjamin Inc.
6. P W Atkins Molecular Quantum Mechanics.

Unit T - 402 Chemical Bonding (15 L)

a) The hydrogen molecule ion (3 L)

The molecular orbital theory for the ground state. Excited States of H_2^+. The molecular orbital and valence bond treatments for the ground state only of hydrogen molecule.

b) MO and VB treatments of more complex diatomic molecules (qualitative) (3 L)

Li2, Be2, C2, N2, O2 and F2 are to be discussed as examples of homonuclear diatomic molecules. LiH, CO, MO and HF are to be discussed as examples of heteronuclear molecules. Spectroscopic term symbols for diatomic molecules.

Contd....3.

(5)

Unit P - 404 Theory of Instrumentation (6 L)

Instrumentation of UV, IR, PMR, ESR and Mass spectrometry.

References:

1. H.H Willard, L L Merrit and J A Dean,
Instrumental Methods of Analysis, Van Nostrand.

Paper II. Inorganic Chemistry - I (66 L)

Unit I 401: The Metallic State (16 L)

Theories of metallic bonding: Free electron theory, band and zone theory. Thermal and electrical properties of metals interstitial and substitutional alloys, intermetallic compounds, Hume-Rothery rules.

Borides, carbides, nitrides and silicides.

Metallic corrosion and possivity: Electrochemical theory, protection against corrosion, possivity of metals.

Principles of powder metallurgy.

References:

1. Introduction to solids, L V Azaroff
2. Structural inorganic Chemistry, A F Wells.
3. Electrons, atoms, metals and alloys, Hume.W.Rothery
4. Principles of metallic corrosion, T H Chilton
5. Corrosion and oxidation of metals, R C Evans
6. Introduction to Physical metallurgy, S H Avner Mc-Graw Hill, New York, 1964.

Unit I - 402 Coordination Compounds (12 L)

Formation and stability of complexes, concept of hard and soft acids and bases. Chelate effect, macrocyclic effect. Nature of metal-ligand bond. The EAN rule, Valence Bond, Crystal Field and Ligand Field theories. Ligand field stabilization. Jahn-Teller effect, Spectrochemical and nephelauxetic series. An introduction to the Molecular orbital theory.

Contd.....2.

References:

1. Advanced Inorganic Chemistry, F A Cotton a G Wilkinson
2. Theoretical Inorganic Chemistry, M C Day and Selbin.
3. Inorganic Chemistry, J E Huheey.
4. Coordination Chemistry, Basolo & Johnson.
5. Coordination Chemistry, S F A Kettle.
6. Chemistry of the Coordination Compounds, J C Bailar (Jr) (Ed).
7. Inorganic Chemistry, K F Purcell and J C Kotz W B Saunders Company, Philadelphia.

Unit I - 403 Lanthanides and Actinides (9 L)

Separation by ion-exchange and solvent extraction methods. Electronic configuration, oxidation state, atomic and ionic radii, absorption spectra. Comparison of coordination Chemistry with that of transition metals. (Lanthanide chelates.) Applications of Lanthanides, Th and U. Trans-actinide elements.

Reference:

1. Chemistry of Lanthanides, T Moeller.
2. The Trans-uraniun Elements, G T Seaborg.
3. Man-made Trans-uranium Elements, G T Seaborg.
4. Inorganic Chemistry, J E Huheey.
5. Advanced Inorganic Chemistry, F A Cotton a G Wilkinson.

Unit I - 404 Inorganic Rings and Chains. (7 L)

Inorganic heterocycles : Compounds with S-N, P-N and P-S rings. Polyphosphazines and plymeric sulphur nitride.

Borazines, Coordination polymers, silicones.
Isopoly and heteropoly acide of Mo and W

Reference:

1. Modern Aspects of Inorganic Chemistry, H J Emeleus a A G Sharpe.

Contd...3.

2. Structural Inorganic Chemistry, A F Wells.
3. Advanced Inorganic Chemistry, F A Cotton a G Wilkinson.
4. Inorganic Chemistry, J E Huheey.
5. Phosphorus-Nitrogen Compounds, H R Allcock.
6. Inorganic Sulphur Chemistry, S Nickelers (Ed).
7. Organometallic Polymers, C E Carraher (Jr). J E Sheats a C U Pittmann (Ed), pp 313-321.
8. Inorganic Ringsand Chains, D A Armtage.
9. Developments in Inorganic Polymer Chemistry, M F Lappert a G J Leigh.

Unit I - 405 Electron-deficient Compounds (7 L)

Synthesis, reactions, structure and bonding of boron hydrides and related compounds. Equation of balance. Polyhedral anions. A Brief study of carboranes and metalloboranes.

References:

1. Modern Aspects of Inorganic Chemistry, H J Emeleus a A G Sharpe.
2. Advanced Inorganic Chemistry, F A Cotton a G Wilinson.
3. Inorganic Chemistry, J E Huheey.
4. K F Purcell and J C Kotz Inorganic Chemistry W B Saunders Company, Phiadelphia (6 L)

Unit I - 406 Reaction in Non-aqueous Solvents (9 L)

Classification of solvents. Solute-solvent interaction, self-ionization of solvents. Reactions in liquid ammonia, liquid hydrogen fluoride, liquid sulphur dioxide, and sulphuric acide. Super acids.

References:

1. Chemistry of Non-aqueous solvents, H H Sisler.
2. Non-aqueous Solveats, T C Waddington.
3. Theoretical Inorganic Chemistry, M C Day a Selbin.

Contd...4.

Unit I - 407 Inorganic Pigments (6 L)

Titanium dioxide, red lead, ultramarine, etc. Luminescent Pigments based on zinc sulphide.

References:

1. Encyclopedia of Chemical Technology, Kirk-Othmer series, Volume 15.
2. Pigments Part I, R R Myres a J S Long (Ed).

Practical I Inorganic Chemistry - I (36 LS)

Unit I Separation and identification of four metal-ions of which two are less familiar elements like Tl, W, Sc, Te, Mo, Ce, Th, Ti, Zr, V, U and Li. (Eliminating acid radicals not present). Confirmation by spot tests. (16 LS)

Unit II Volumetcic Determinations using:

a) EDTA;Al, Bo, Ca, Cu, Fe, Ni, Ca, hardness of water etc)
b) Cerimetry (Fe^{2+}, nitrite)
c) Potassium iodate (iodide, Sn^{2+}) (12 LS)

Unit III Colorimetric determination of chromium, iron, manganese, nickel, and titanium using either Duboscq or photoelectric colorimeter. (8 LS)

Referances:

1. A Text Book of Qualitative Inorganic Analysis, A I Vogel.
2. Analytical Chemistry, D A Skoog a D M West.
3. Quantitative Chemical Analysis, I M Kolthoff, E B Sandell.
4. Quantitative Analysis, R A Day (Jr) a A L Underwood.

(LS : Laboratory Session)

Paper II - Organic Chemistry I (66 L)

Unit O - 401 Stereo Chemistry (15 L)

a) Optical isomerism (6 L)

Molecular asymmtry dissymmetry, - Different projection formula Optical activity due to molecular structure and compounds containing more than one asymmetric carbon atom. Relative and absolute configuration. D and L notation Sequence rule (R and S notation). Optical isomerism of compounds not containing asymmetric carbon atoms - Biphenyls, allence and spirans, asymmetry due to folding or helical structure - hexabelicenes and trans cyclooctene. Optical isomerism of nitrogen and sulphur compounds and of cyclic and bicyclic compounds (Truxilic acids and substituted adamantanes).

b) Geometrical isomerism with particular reference to ring compounds. E-Z notation with illustrations from acyclic systems. Methods of determining configurations of geometrical isomers - inositol and hexachlorocyclohexanes - compounds containing C N and N=N double bonds. (3 L)

c) Conformational analysis (6 L)

Conformations of 1, 2-dihaloethane - determination by measurement of dipole moments - Conformations of cyclobutane and cyclopentane. Detailed study of conformation of cyclohexanes with energy considerations - dimethyl, dihalo, dihydroxy cyclohexanes, alkyl cyclohexanols, cyclohexane dicarboxylic acids. Conformations of bicyclic systems. Medium and large rings. Fused ring systems - decaline, monosubstituted decalins, 1 and 2 - decalols and decalyl amines, Conformation and reactivity - Reactions at exocyclic and at ring positions - steric control and stereo electronic factors.

Contd...2

Unit O 402.

Mechanism and the methods of determination

Types of mechanisms - Types of reaction Thermodynamic requirements for reaction kinetic requirements - for reaction. Baldwin rules for ring closure. Kinetic and thermodynamic control. The Hammmd postulate. Microscopic reversibility. Methods of determination: Indentification of products, Determination of the presence of one intermediate. The study of catalysis. Isotopic laeling. Stereochemical evidence. Kinetic evidence. Isotopic effect.

Ref: Jerry March: Advanced organic Chemistry 3rd edition
Carray & Saunders: Advanced Organic Chemistry
Plenum Press.
Eliel, Stereochemistry of carbon compounds, 1962.
Eliel, et al Conformational analysis.
Nasipuri Stereochemistry of carbon compounds,
Wiley Eastern.
Finar Vols. I and II Organic Chemistry.
P S Kalsi, Stereochemistry, Wiley Eastern

Unit O - 403.

Introduction to Physical Organic Chemistry (14 L)

a) Mechanism with stereochemistry of nucleophilic substitution Substituent effects (a comparative study of the inductive, mesomeric, electromeric, inductomeric and steric effects on reactivity. (6 L)

b) Quantitative correlations of substituent effect with special reference to Hammett and Taft equations, their applications and steric substituent constants. (3 L)

c) Solvent effects comprising basic aspects of solvent structure, empirical measures and parameters of solvent polarity (like y-value), hydrogen bonding, Salt effects. Carbocations of special interest. (elementary ideas only) (3 L)

Contd....3

1. Jerry March, Advanced Organic Chemistry, 2nd edition, 1977.
2. Solomen: Advanced organic chemistry, John Wiley Son, Inc.
3. Carry and Saunders: Advanced Organic Chemistry, Plenum Press.
4. I L Finar, Organic Chemistry Vol. I & II.

Unit O - 404. Acidity/Basicity of Organic Compounds (3 L)

Evaluation of acidity and basicity and determination of acidity constants for strong and weak acids.
Hammett acidity function (Applications only)

References:

1. Hine. Physical Organic Chemistry (2nd Edn.) McGraw Hill Book Company, London (1962).
2. L P Hammett, Physical Organic Chemistry, McGraw Hill Company, London: (1940). USE 2nd edition if evailable.

Unit O - 405. Free Radical Reactions (6 L)

Stability of Free radicals, Sources and determination of free radicals, chain reactions - retardation and aceleration of, and induction period of. Structural and stereochemical aspects of radical intermediates, Free-radical substitution reactions (Halogenation, oxidation and substitutions involving aryl radicals), Rearrangements and fragmentation, carbenes, Nitrenes application.

References:

1. Advanced Organic Chemistry by J March 2nd ed. 1977.
2. Reaction Mechanism in Organic Chemistry by S M Mukherji and S P Singh 1976.
3. Principlesof Reaction Mechanism by V S Parmar and H M Chowla 2nd Edn. 1978.
4. Caray & Saunders - Advanced Organic Chemistry Part A & B
5. Finar: Organic Chemistry Vol.I & II Plenum Press.

Contd...4.

Unit O - 406. Basic Reaction Mechanisms. (12 L)

a) Mechanisms of elimination - effect of base, steric effect, stereochemistry, pyrolytic eliminations, classification of elimination on the basis of relative positions of the eliminating groups, competition between elimination and substitution. (6 L)

b) Mechanisms of polar addition to carbon-carbon multiple bonds - addition of halogens, of strong acids of carbonium ions and of metal cations. (3 L)

c) Mechanism of Ester hydrolysis: Acyl-oxygen, and alkyl-oxygen fissions of esterification and of hydrolysis, reactivity and catalysis. (3 L)

References:

1. E S Gould, Mechanism and structure in organic chemistry 2nd edition.
2. Jack Hine, Physical Organic Chemistry, 2nd edition 1962.
3. C M Ingold, Structure and Mechanism in Org. Chemistry 2nd edn. 1969.
4. D V Banthrope, Elimination Reactions, Elsevier Publishing Co., London 1963.
5. Finar: Organic Chemistry Vol. I & II.

Unit O - 407. Aromaticity. (9 L)

Theories of aromatic character and delocalised bonding. Huckel's theory and its applications explaining aromatic stability. Energy levels of molecular orbitals in simple systems. Non-benzenoid and pseudoaromatic compounds. Alternant and non-alternant hydrocarbons. Homoaromatic and antiaromatic systems. Annulenes.

Contd....5

Unit O - 408. Aromatic Substitution:

Electrophilic aroma substitution. Theory of reactivity and orientation. Typicalexamples of electrophilic aromatic substitution mechanisms Nitration, Halogenation, Friedel-Crafts reaction, sulphonation.

Neucleophilic aromatic substitution - Mechanism, statement and evidences. Benzyne mechanism - cine substitution.

Unit O - 409. Reactions of Carbon - heter multiple bonds (6 L)

Nucleophilic and electrophilic additions to carbon - oxygen double bonds. Mechanistic approach - Addition of Water, alcohols, amines, hydrazine derivatives - aldol, perkin Claison, Dieckmann, Stobbe and benzoin condensations. Darzons, Knoevenagel, Reformatsky, Wittig, Cannizaro, Mannich and Prins reactions. Meerwein - Pondorfverley Reduction, Oppenhauer oxidations. Stereochemistry of carbonyl additions Cram's rule. Esterification and hydrolysis - Hydrolysis, alcoholysis and reduction of nitriles - Ritter reaction and Thorpe condensation.

References for 404, 405, 406 and 407:

1. J March, 'Advanced Organic Chemistry'.
2. Morrison and Boyd 'Organic Chemistry'.
3. P Sykes 'Guide book to Mechanism in Organic Chemistry'.
4. Pine, Hendrickson, Cram and Hammond, Organic Chemistry.
5. Ad. Org. Chemistry - Carey & Sunberg.
6. Finar: Organic Chemistry Vol I & II

Unit O - 408. Introduction to Polymer Chemistry (3 L)

Principles of Polymerization - classes of polymers - synthetic and biopolymers - chain reaction polymerization and step reaction polymerization. Linear, crosslinked and network polymers. Free-radical, ionic and Co-polymerization. Natural and synthetic rubber.

References:

1. Hendrickson, Cram and Hammond Pine 'Organic Chemistry'.
2. Saunders 'Organic Polymer Chemistry', Chapman and Hall.

Contddd.6.

Practical II - Organic Chemistry I (36 LS)

Unit I Laboratory Techniques

Methods of separation and purification of organic compounds - fractional, steam and low-pressure distillation, fractional crystallisation and sublimation. (4 LS)

Unit II Separation and identification of the components of organic binary mixtures

Analysis of about ten mixtures, some of which containing compounds with more than one functional group. Identification of the compounds by determing the Physical constants, melting point of derivatives and by reference to table. (18 LS)

Unit III Organic Proparations

Preparation of about twelve organic compounds (at least six double stage preparations) illustrating important synthetic methods and reactions such as Friedel-Crafts reaction, Grignard, Perkin, Reimer-Tiemann, Sandmeyer, and Cannizzaro reactions, Claison, Aldol, and benzoin condensations. Selective reduction in polynitro aromatic compounds; diazocoupling, phthalein fusion etc. (14 LS)

References:

1. A I Vogel, a text-book of practical organic chemistry.
2. Shriner, Fuson and Curtin, Systematic Identification of organic compounds 1964.
3. Experiments in organic chemistry by Fieser
4. Mann and Saunders, Practical Organic Chemistry, 1957,
5. Dey, Sitaraman, and Govindachari, A Laboratory Mannual of Organic Chemistry, 1957 (Third edition).
6. P R Singh, D C Gupta and K S Bajpai, Experimental Organic Chemistry, Volumes 1 and 2, 1980.
7. Practical Organic Chemistry by Vishnoi.

PAPER IV - PHYSICAL CHEMISTRY I (66 L)

Unit P - 401. Solid State Chemistry (24 L)

(a) Crystalline State. Crystal symmetry. Symmetry elements and symmetry operations. Allowed combinations of operations leading to 32 crystal classes. Mathematical proof for the nonexistence of 5 - fold axis of symmetry. Hermann - Mauguin notations. Stereographic projections of some simple crystal classes (1, I, m, 2, 2/m, 2mm, 222, mmm) (12 L)

(b) Electronic structure of solids (Brief mention only). Classification of solids into conductor, semiconductors, and insulators. Preparation, properties and industrial importance of Semiconductors. (3 L)

(c) Imperfections in solids. Point, line and plane defects. Electrons and holes. Nonstoichiometry (3 L)

(d) Imperfections and physical properties of solids.

i) Electrical properties - Electrical conductivity, Hall effect, dielectric properties, piezonelectricity, ferroelectricity and ionic conductivity.

ii) Optical properties - photoconductivity, luminescence, colour centres, lasers, refraction, birefringence.

iii) Magnetic properties - diamagnetism, paramagnetism ferromagnetism, antiferromagnetism and ferrimagnetism.

iv) Thermal properties - thermal conductivity and specific heat.

v) Mechanical properties: Strength of real crystals as compared with an ideal crystal, different strengthening mechanisms. (6 L)

Contd....2.

References: 2

1. G.R.Ramachandran, Academic Press, 1964 Advanced elements of crystollography.
2. WP de Jong, W H Freeman and Company, General crystallography - A brief compoundium.
3. L V Azaroff, McGraw-Hill Introduction to solids.
4. G M Barrow, McGraw-Hill Physical Chemistry.
5. W J Moore, Prentice-Hall Physical Chemistry.
6. A K Galway, Chapman and Hall Chemistry of solids.
7. N B Hannay, Prentice-Hall Solid State Chemistry.
8. J Arud Hedwell Elsevier Solid State Chemistry.
9. A R West John Wiley Solid State Chemistry.

Unit P - 402 Thermodynamics (12 L)

a) Third law of thermodynamics

Statement. Determination of absolute entropies using the third law. Unattainability of absolute zero. Residual entropy.

Determination of relations connecting the thermodynamic partial derivatives by the method of Jacobians (The discussion to be confined to closed thermodynamic systems.) (3 L)

b) The thermodynamics of solutions

Partial molar quantities. The general method for their determination. Deviations from Raoultes law. Excess thermodynamic functions. Excess free energy, excess entropy, excess enthalpy and excess volume. (3 L)

c) Thermodynamics of irreversible processes

Simple examples of irrevessible processes. Entropy production. The phenomenological relations. Onsager reciprocal relations. Application of the theory to diffusion, thermal diffusion, thermo-osmosis and thermomolecular pressure difference. (6 L)

Contd....3.

Text books recommended

1. Daniels and Alberty, John Wiley Physical Chemistry.
2. H Margueman and G M Murphy, Vol.I, Chap.I the Mathematics of Physics and Chemistry.
3. R P Rastogi and R R Misra, Vikas An Introduction to Chemical Thermodynamics.
4. I Pigggine, Interscience An Introduction to the Thermodynamics of Irrevessible Processes.
5. J Rajaram and J C Kuriacose Thermodynamics. Nagi n chand & Co., Delhi - 1986.
6. Yeramin, Mir Publishers Moscow Chemical Themodynamics.
7. Lewis and Randall Thermodynamics.

Unit P - 403 Electrochemistry (15 L)

(a) Theory of electrolytic conductance: Ionic atmosphere. Relaxation effect (assymetry effect). Electrophoretic effect. Derivation of Debye - Huckel - Onsagar conductance equation and its verification (aqueous and nonaqueous solutions). Deviation form Debye-Huckel - Onsagar equation and corrections. Conductance ratio. Debye Falkenhagen effect. Wein effect. (6 L)

(b) Activity and activity coefficients (different forms). Activities of electrolytes. Ionic strength. Variation of activity coefficient with concentration. Debye - Huckel limiting law (Debye - Huckel equation) and its various forms (Derivation). Qualitative and quentitative tests of the limiting law. (3 L)

(c) Polarization Over voltage and polarography: Electrolytic Polarisation. Dissolution and deposition potentials. Concentration polarizstion. Decomposition voltage (Potential) and its determination. Overvoltage - Hydrogen overvoltage, oxygen overvoltage, metal deposition overvoltage and their determination. Mechanism of anodic and cathodic processes (Theories of overvoltage) - Ionic diffusion as the slow process

Contd...4.

5. John M Knox, "Gas Chromatography", London Mathuan & Co.
6. Gerasinov, et al., "Physical Chemistry, Vol.I, Mir Publication.
7. Willard & Merritt, "Instrumental Methods of Chemical Analysis", Sixth Ed., CBS Publishers & Bistributors, Delhi.

Unit: P - 405 Introduction to Computers (6 L)

Analog and digital computers. Generations of computers. Basic ideas of CPU, input and output devices, memory. Introduction of the terms: ROM, RAM, PROM, EPROM, EEPROM, Floppy drive - diskettes, Hard disk. Hardware and software. Binary system. Hexadecimal system. Storage of informations - EBCDIC, ASCII, BCD. Programming - Languages: Machine, Assembly and High level languages. Interpreter and compiler. Flow charts. Algorithm.
System software and application software.
Introduction to BASIC Language. Numeric constants and veriables, string variables. Symbols of arithmetic operations. Hierrchy of operations. Statements such as REM, PRINT, LET, INPUT, READ, DATA, IF - THEN, GOTO, FOR-NEXT, GOSUB-RETURN, WHILE - WEND, ON-GOTO, ON-GOSUB, DIM, END. User defined functions.

Systeme commands such as DIR, MD, CD, LIST, SAVE, LOAD, RUN, CLS, COPY, DEL, PRINT, FORMAT.
Entering and editing statements.

References:

1. Madric and Donevan, "Understanding Computers" McGraw Hill
2. N Subramanian, "Programming in BASIC", A L wheeler and Co.
3. Stewart M Venit. "Programming in BASIC, Problem solving with Structure and Style", Jaico Publishing House, Bombay.
4. Jaffray B Norton, "Introduction to BASIC", BPB Publishers.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with BASIC including Expanded Microcomputer BASIC Section", Mc Graw Hill.

Ionic discharge as the slow process. Principles of polarography. The dropping mercury cathode. The half wave potentials (6 L)

1. D A McInnes, The Principles of Electrochemistry, Dover Publications.
2. S Glasstone, Introduction to Electrochemistry, D Van Nostrand.
3. Bockris and Reddy, Modern Aspects of Electrochemistry Vol. I and II, Academic Press.
4. L I Anthropov, Theoretical Electrochemistry, Mir Publishers Moscow

Unit P - 404 Colloids and Surface Phenomena (9 L)

Colloidal surfactants - Classification - Anionic, Cationic and Non-ionogenic surfactants. Miceller solutions-Causes of micelle formation. HLB numbers. Micelle structure. Determination of critical concentration of micelle formation. Stabilizing action of surfactants. Solubiliz in surfactant solutions. Practical importance of colloidal surfactant solution - Tannins and dyes.

Langmuir adsorption isotherm - statistical derivation. The B E T Equation - derivation. Determination of surface area of adsorbents. Heat of adsorption and its determination.

Adsorption Indicators. Chromatography: Gas, Thin layer and HPLC. Plate theory and Rate Theory (no derivation) Factors affecting band broadening.

References:

1. S Voyutsky, "Colloid Chemistry" Mir Publishers, Moscow.
2. N K Adam, "The Physics and Chemistry of Surfaces", Dover Publications.
3. A W Adamson, "Physical Chemistry of Surface", Wiley-Interscience.
4. V K Gupta and R G Sharma, "Advanced Physical Chemistry", K Nath & Co.

Contd....5.

PRACTICAL III - PHYSICAL CHEMISTRY I (30 LS)

(A minimum of 15 experiments covering all the listed experiments shall be carried out for full credit.)

Unit I - Solubility (expt.) (2 LS)

1. Heat of solution from solubility data
   (Systems: ammonium oxalate, succinic acid)

Unit II - Cryoscopy (3 expts.) (6 LS)

1. Molecular weight of a solid using a solid solvent by cooling curve method.
   (Solvents: naphthalene, biphenyl, naphthalene, m - dinitrobenzene, p-chlorobenzene)

2. Molecular weight of a solid using a liquid solvent by cooling curve method.
   (Solvent: water. Solutes: urea, glucose)

3. Study of the reaction, $2\ KI + HgI_2 = K_2HgI_4$
   Determination of concentration of KI solution.

Unit III - Partition method(1 ext.) (3 LS)

1. Distribution of I_2 between CCl_4 and H_2O
   Study of the reaction, $KI\ I_2 = KI_3$
   Determination of concentration of KI solution.

Unit IV - Refractive index (1 expt.) (3 LS)

1. (a) Refractive indices (Molar refraction) of pure liquids (water, methyl alcohol, ethyl alcohol, chloroform, carbontetrachloride, glycerine)
   (b) Composition of binary systems (glycerine-water, KCl - water).

Contd....

Unit V - Viseosity (5 expts) (4 LS)

1. (a) Viscosity of pure liquids (water, methyl alcohol, ethyl alcohol, benzene, nitrobenzene, carbontetra chloride).
   (b) Composition of binary liquid mixtures (benzene - nitrobenzene, water - alcohol)
   (b) Molecular weight of a polymer (Polystyrene in toluene)

Unit VI - Conductivity (4 expts.) (12 LS)

1. Equivalent conductance of a weak acid (HOAc) - Verification of Ostwald's law and calculation of dissociation constant.
2. Equivalent conductance of a strong electrolyte (KCl) - Verification of Onsager equation.
3. Solubility product of a sparingly soluble salt (Ag Cl, Ba SO_4, Ca CO_3).
4. Conductance titration: HCl x Na OH, (HCl + HO Ac) x Na OH, Ag No_3 x KCl.

Unit VII - Potentiometry (3 expts.) (6 LS)

1. Differential potentiometric titrations: HClxNaOH.
2. Redox titrations: KIxKMno_4, Fe SO_4 x $K_2Cr_2O_7$.
3. Dissociation constant of HOAc by potentiometric titration.

References

A Findlay Practical Physical Chemistry, Longman's, Gree a Co.
A M James Practical Physical Chemistry J A Churchill Ltd.
R A Alberty and others Experimental Physical Chemistry, McGraw Hill.
W G Palmer Experimental Physical Chemistry Cambridge University Press.
D P Shoomaker and C W Garland Experiments in Physical Chemistry McGraw Hill

(LS = Laboratory Session (2 hours).

Inorganic Chemistry II (90 L)

Unit - 501 Magnetic prpperties of transition metal complexes

Types of magnetic behaviours. Paramagnetism: temperature dependence, spin and orbital contributions, spin-orbit coupling : LS and JJ coupling schemes. The spin-only moment and its application in coordination chemistry of the transition metals. Magnetic properties of lanthanide complexes. Temperature independent paramagnetism.

Determination of magnetic susceptibility by Gouy's method. Antiferromagnetic interaction in transition metal complexes. Magnetic properties of heavier transition metal complexes.

Reference:

1. Techniques of Inorganic Chemistry Vol. IV, H B Johaseen a A.Weissberger (Eds).
2. Modern Coordination Chemistry, J Lowis a R G Wilkins.
3. Magnetochemistry, A Earnshaw.

Unit I - 502 Spectra of Transition Metal Complexes. (14 L)

Visible Spectra:

Ground state term symbols for various d^n electronic configurations. Electronic transitions responsible for colour of transition metal complexes: d-d transition and its selection rules. Orgel diagram for d^1, d^4, d^6 and d^9 electronic configurations of metal ions in complexes. Reasons why this diagram differs from Tanabe-Sugano diagram. (The latter diagram is not expected, only the qualitative reasons for the difference required).

Charge transfer transitions: Analytical applications of charge transfer spectra in the visible region.

A brief qualitative introduction to circular dichroism (CD), optical rotatory dispersion (ORD), and cotton effect of optically active complexes. Infrared spectra: changes in

Contd....

the infrared spectra of donor molecules upon coordination.

Electron spin resonance spectra: Application to copper complexes.

References:

1. Transition Metal Chemistry, L E Orgel.
2. Physical Methods in Inorganic Chemistry, R S Drago.
3. Modern Coordination Chemistry, J Lewis a R G Wilkinson.
4. Advanced Inorganic Chemistry, F A Cotton a G. Wilkinson.

Unit I - 503 Mechanism of Inorganic Reactions in Solution (12 L)

Ligand substitution in octahedral complexes: SN1, SN2 and SN 1CB mechanisms. Acid and base hydrolyses. Anation reactions. Origin and significance of trans effect in square planar complexes. Electron transfer and electron exchange reactions. Principles of photochemical reactions of coordination compounds.

Reference:

1. Advanced Inorganic Chemistry, F A Cotton a G Wilkinson.
2. Mechanism of Inorganic reactions in Solution D Benson.
3. Mechanism of Substitution Reactions of Metal Complexes. F Basels a R G Pearson.
4. Fundamentals of Photochemistry, K K Rohatgi-Mukherjee.

Unit I 504: Transition metal complexes of H2, N2, O2, NO and tertiary phospines.

Reference:

1. Advanced Inorganic Chemistry,
F A Cotton and G Wilkinson, John Wiley,
New york, Fourth Edition, 1980.

Unit I - 505 Organometallic Compounds (24 L)

Nomenclature and classification

Compounds with metal-carbon single bond: Alkyls and Aryls of main group elements.

Contd....

Transition metal to carbon multiplembond: Metal carbonyls, cyano complexes and complexes of organo isocyanides. Usefulness of eighteen electron rule in predicting formation and stability organometallic Complexes.

Pi-complexes: Notal complexes of ethyleno, acetylene, allyl and butadiene. Cyclepentadienyl complexes of iron group metals and arene complexes of chromium group metals Fluxional organometallics.

Metal-metal bonding in carbenyl and halide clusters, Cluster bonding theories.

Unit I - 506 Hemogeneous and Heterogeneous Catalysis Involving Organometallics (12 L)

Oxidative additon, reductive eleimination, insertion and extrusion reactions, hydrogenation, carboxylation, hydroformylation, and Ziegler-Natta polymerisation of elefins.

Reference for Unit 505 and 506.

1. Advanced Inorganic Chemistry, F A Cotton a G Wilkinson 4th edu 1980.
2. Inorganic Chemistry, J E Huheey.
3. Modern Aspects of Inorganic Chemistry, H J Emeleus a A G Sharpe.
4. Principles of Organometallic Compounds P Powell, Chapman and Hall, 1988.
5. Organometallic Chemistry - An Introduction, R C Mehrotra a A Singh, Wiely ecntern, 1991.
6. Inorganic Chemistry, K F Purcell and J C Kolz, W B Sanders Company, Philadilphic.

Unit 507 - Bioinorganic Chemistry (12 L)

Essential and trace elements in biology, metal porphyrins, heamoglobin and myoglobin cytochromes, cobalamines, brief idea on metalloenzyines, Fe - S proteins, Nitrogen fixation, photosynthesis

References Reference numbers 1, 2 and 6 cited in Units 505 and 506

Contd....2.

Practical IV - Inorganic Chemistry II (44 LS)

Unit 1 Estimation, involving quantitative separation, of suitable binary mixtures of ions Cu^{2+}, Ni^{2+}? Fe^{3+}, Zn^{2+}, Ca^{2+}, Mg^{2+}, $Cr_2O_7^{2-}$, Ba, Ag, etc. in solution by volumetric, gravimetric, Colorimetric, and electroanalytical methods. Estimation of three cations when present together (Cu, Ni, Zn: Fe, Ni Zn, Cu, Ni, Mg, etc (20 LS)

Unit II Analysis of ores and alloys like dolomite, galena, ilmenite, monazite, feldspar and kaoline, and two alloys. (10 LS)

Unit III Ion-exchange separation of binary mixtures: Zn^{2+} and Mg^{2+} and of Co^{2+} and Ni^{2+}. (4 LS)

Init IV Inorganic Preparations: (10 Nos). (6 LS)

Unit V Soil and fertilizer analysis: Determination of pH, and NPK estimation. (4 LS)

References:

1. A Text Book of Quantitative Inorganic Analysis, A I Vogel.
2. Quantitative Chemical Analysis, I M Kolthoff a E B Sanderson.
3. Technical Methods of Ore Analysis, A J Weining and W P Schoder.
4. Analysis of Minerals and Ores of the Rarer Elements, W R Schoeller and A R Powell.
5. Advanced Practical Inorganic Chemistry, D M Adams a J B Raynor.
6. Experimental Inorganic Chemistry, W G Palmer.
7. Inorganic Syntheses, Collective Volumes.
8. Preparative Inorganic Reactions, N L Jolly (Ed).
9. Handbook of Preparative Inorganic Chemistry, Vol. I a II G Brauer.

Contd...

Unit I Determination, involving quantitative separation, of suitable binary mixtures of ions Cu^{2+}, Ni^{2+}, Fe^{3+}, Cr^{3+}, Co^{2+}, Mo^{2+}, Fe^{2+}, Co^{2+}, Be, Al, etc. in solution by volumetric, gravimetric, colorimetric and electrometric methods. Determination of three cations when present together (Co^{2+}, Ni^{2+}, Fe^{3+}, Mn^{2+}, Cu, Ni, Mg etc. (20 Ls)

Unit II Analysis of ores and alloys like dolomite, dolomite, limonite, monazite, ferrochrome and kaolin, and two alloys. (10 Ls)

Unit III Ion-exchange separation of binary mixtures Zn^{2+} and Mg^{2+} and of Co^{2+} and Ni^{2+} (4 Ls)

Unit IV Inorganic Preparations (10 Ls)

Unit V Soil and fertilizer analyses: Determination of pH, and NPK estimation. (4 Ls)

References:

1. A Text book of Quantitative Inorganic Analysis, A I Vogel.
2. Quantitative Chemical Analysis, I M Kolthoff & E B Sandersen.
3. Technical Methods of Ore Analysis, A O Hutchins and W P Schoder.
4. Analysis of Minerals and Ores of the Rarer Elements, W F Schoellar and A R Powell.
5. Advanced Practical Inorganic Chemistry, Dick Adams & J B Raynor.
6. Experimental Inorganic Chemistry, W C Palmer.
7. Inorganic Syntheses, Collective Volumes.
8. Preparative Inorganic Reactions, W L Jolly (Ed).
9. Handbook of Preparative Inorganic Chemistry, Vol. I & II G Brauer.

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Paper VI - Organic Chemistry II (90 L)

Unit O - 501: Physical methods in organic chemistry (20 L)

Applications of U V., I R E S R Mass, C.D.; O R D., Spectroscopy and dipole moments in structural elucidations of organic compounds. Use of the plain and cotton effect curves for determining configurations and conformations. Octant rule and axial haloketone rule.

NMR: Proton NMR - Shielding, deshielding Proton chemical shift-Anisotropic effect and proton chemical shift, chemical and Magnetic equivalance, chemical shift assignments for mgior functional groups - Quadrupole boardening in N H signals. Spin-Spin coupling & Spin-Spin splits, First order and non first order spectra. Magnitude of Coupling-Coupling constants J. Factors, influencing coupling constants.

^{13}CNMR: Chemical shift assignments in carbon - 13 NMR spectra H-Decoupling-noise decoupling -broad band decoupling Off reseonance Decoupling - Structurel applications of ^{13}CNMR.

Mass Spectra: Basic Principles, Isotope abundanace Molecular ion, Metastable ions-its significance, Fragmentation process, Fragmentation associated with functional group.

References:

1. Silverstein: Spectroscopic identification of organic Compounds.
2. Kemp: Organic Spectroscopy.
3. Kalsi Organic Spectroscopy.
4. Nasipuni: Stereochemistry of organic compounds.
5. Relevant chapters in organic chemistry by Pine, Hendrickson et al.
6. Final Vol.I a II.
7. Problems in advanced organic chemistry by Jerry March.

Contd....

Unit O - 502: Organic Photochemistry (9 L)

Fundamental concepts, molecular excitation, Jablonski diagram, the triplet state, photosensitization, photoreactions of organic molecules, reactions involving the olefinic double bonds, reactions of carbonyl compounds, oxidation and reduction, photo-Fries rearrangement, photolysis of nit te esters and related compounds, photochemistry of some life processes: Photosynthesis, industrial and technological applications of photochemistry- Photographic Processes photochemical degoadation of polymers. Photochemistry of Dyes and Pigorents Photochemistry in Synthesis. Photoelectrochemical Cells, Energy conversion and storage.

References:

1. Kan, R O Organic Photochemistry, McGraw Hill Book Co. (1966).
2. Chapman, O L Organic Photochemistry, Volumes I & II Marcel Decker Inc. (1967 and 1970)
3. Lamola, A A and Turro, N J., Energy transfer and Organic Photochemistry, (Technique of organic chemistry series Vol. (xiv), Interscience Publisher (1969).
4. Chapman, O L and Depuy, Molecular reactions and Photochemistry (Foundations of modern organic Chemistry series), Prentice Hall (1972).
5. Calvert and Pitts, Photochemistry, John Wiley Interscience (1966).
6. Cox and Kemp Introductory photochemistry, John Wiley Interscience (1966).
7. Chemistry and light P Sappan 1996 Royal Society of Chemistry London [illegible] of Pericyclic reaction.

Unit O 503: Pericyelic reactions

Pericyclic reactions - Electrocyclic, Cycloaddition reactions and sigmatropic rearrangements with hydrogen and allayl shift-stereochemistry Woodward HOffman theory of

Contd....

of M O Symmetry - Application of W H theorey by method of correlation diagram - M O correlation diagram and rate correlation diagram. Stereochemistry by method of arometicity and by method of FMO overlap. Cope rearrangement - claison rearrangement. Industrial applications of the above two rearrangements.

[illegible] rearrangements.

[illegible] reactions.

References:

1. Entwistle, No, 'Orbital symmetry correlation in org. Chemistry - A guide to woodward - Hoffmann rules'.
2. Pine, Hendrickoon, Cram and Hammend, 'Organic Chemistry'.
3. J March, Advanced Organic Chemistry 2nd Ed. 1977.

Unit O - 504: Molecular rearrangements (9 L)

Rearrangements involving electron deficient carbon, nitrogen and oxygen atoms: Wagner-Meerwein, Pinacol-pinacolone, Dienone-phenol, Wolff, Hofmann, Curtius, Lossen, Beckmann, Schmidt and Baeyer-Villinger rearrangements, anionic rearrangements: benzil-benzilic acid and Favorski rearrangements, aromatic rearrangements: Orton, Claison and Fries rearrangements.

References:

1. Sykes, A Guide book to Mechanisms in Organic Chemistry Orient Longman (3rd Ed. 196).
2. Gould, Mechanism and Structure in Organic Chemistry, Holt-Dryden (1959).
3. Pine, Hendrickson, Cram and Hammond, Organic Chemistry Mc-Graw Hill (3rd Ed. 1980).
4. De Mayo, 'Molecular Rearrangements', Interscience 1964).
5. J March, 'Advanced Organic Chemistry', Mc Graw Hill (1978).

Unit O - 505 Heterocyclic compounds containing two or more hetero atoms (6 L)

Contd.....

Methods of synthesi and reactions of imidazole, thiazole, pyrimidine (uracil, thymine, cytosine), pyrazine, purine, pteridine (xanthpterin) alloazine and iso-alloxazine - FAD coenzyme Structure and synthesis of adenine, granine, uric acid and caffeine.

References:

1. Finar, Organic Chemistry ELBS (1969, 4th Ed.) Vol.II, Cn 12. Heterocyclic compounds containing two or more hetero atoms.
2. Gilman (Ed.) Advanced Organic Chemistry, Wiley Vol, IV (1953), Ch. 8 Heterocyclic Chemistry.
3. Acheson, An Introduction to the Chemistry of Heterocyclic compounds, Interscience (1960).
4. Badger, The Chemistry of Heterocyclic compounds, Academic Press (1961).
5. Rodd (Ed.) Chemistry of the Carbon Compounds, Elsevier, Vol.IV A, B and C 1958 Heterocyclic Compounds.
6. Elderfield (Ed.) Heterocyclic compounds, Wiley (1951).
7. Weissberger (Ed.) The Chemistry of Heterocyclic Compounds, Interscience (1950).

<u>Unit O - 506</u>: Introduction to Chemistry of natural products (21 L)

General methods of isolation classification purifications and structural elucidation of diferent classes plant products (alkaloids, Terpencids, stereoids Flavones and isollavones Detailed study of camphor, abietic acid quinine, atropine, quercetine Woodward synthesis of Choleslerol Conversion of choleslerol to testasterone, progesterone syntheses of Androsterone, estrone, Synthesis of poegestrene from Biosynthetic pathway for monoterpenoids. General deosgenin and citral.

References:

1. Finar Vol. II (5th and 6th editions).

Contd....

2. Higher terpenoids by De. Mayo.
3. The Chemistry of the terpene by A R Pinder.
4. The alkaloids by K H Bently Part I and II.
5. Alkaloids ed. by E M Pelletier 1970
6. Natural products in organic chemistry by O P Sheena (1978).
7. Steroids by Fieser and Fieser.
8. The Chemistry of steroids by Klyne.

Unit O - 507 Introduction to Biopolymers (15 L)

Protection, deprotection (Amino and Carboy - Behivation, Herrifields SPPS.
Primary, Secondary and tertiary structure of proteins. Sequence determination of peptides and proteins. Edman degradation. Structure and synthesis of polypeptide with special reference to glutathione, gramicidin. Structure and synthesis of nucleotides, nucleosides and nucleic acids. Structure of RNA and DNA.

Structure of polysaccharides, cellulose and starch conversion of celbulose to Rayon.

References:

1. Finar, Organic Chemistry, ELBS (1969, 4th Ed.) Vol.II Ch. 16. Purines and Nucleic Acids.
2. Gilman (Ed) Advanced Organic Chemistry of Pyrimidines, Purines and Nucleic Acids.
3. Rodd (Ed) Chemistry of carbon compounds, Elsevier. Vol.IV C (1960) Ch. XX. Purines and Related Ring Systems. Ch. XXI. Mucleosides, Nucleetides and Nucleic Acids.
4. Jordan, The Chemistry of the Nucleic Acids, Butterworths (1960).
5. Pine, Hendrickson, Cram and Hammond 'Organic Chemistry', (1980).

Unit O - 508 Techniques of Purification of Organic Compounds.

Application of Chromatography GLC, HPLC, ionexchange) molecular sieves, Zone refining and counter current extraction.

References:

1. Physical methods in organic chemistry by A Weissberger, Vol.I (1950).

Practical V - Organic Chemistry II (44 LS)

Unit I : Quantitative Organic Analysis.

Estimation of equivalent weight of acids by Silver salt method. Estimation of nitrogen by Kjeldahl method Determination of Acid value, iodine value and saponification value of oils and fats (at least one each, Estimation of reducing sugars. E Stimation of Amino group, phanolic group and esters colourimetric estimations: Vitmmins (Ascorbic acid), Drugs - sulpha drug (Sulpha diazine sulphaguanidine), Antibiotics - Pencillin , Stroptomycis.

Ref: 1. Quantitative organic Analysis: Vogel.
2. Pharmaceutical Analysis: Beebet:

Unit II: Extraction of Naturel products and purification by column chromatography and TLC - Caffeine from Teawaste, Chlorophill Steroids Flavonoid, (Soxhlet extraction citral from lemon glass(steam distillation). C sein from milk.

Unit III: Practical application of PC and TLC preparation of TLC plates, activation. Identification of the following classes of compounds using one and two dimensional Technique. Identification by using spray reagents and co-chromato-graphy by authentic samples and also from Rf values.

1. Food additives and Dyes Artificial sweetness: Saccharine, cyclamates, Dulcin Flavour attul larants peperonal, Benzalacetate, ethyl cetete Antioxidants: Butylated hydroxytoluen (BHT) Butylated hydroxy anisole (BHA), Hydroquinone.

Food colours: permitted - Amaranth, Erythrosine, Tatrazine, susnset yellow, Fast green, Brilliant Blue, Non permitted colours: Auramine, Congo red, Malachite green, Metanil yellow, organge II, Sudan II, Congo red.

b) Amino acids, (Protein hydrolysates), Sugars, Terpinoids, Alkaloids, Flavoncids, Steroids.

Contd....

c) Pesticides and herbicides: Oragono chlorin pesticides organo phosphates and carbamate pesticides, Herbicides.

Plant grouth stimulataes: Indol acetic acid.

Ref: 1. Chromacrography. Edn. Enich Hoftmann, van Norstand Reinhold company, New York 1975

2. TLC and LC analysis of pesticides of International importance; Vol.VI & VII Joseph Sherma, Gunter Zweig. Academic Press

3. Plant Drug Abalysis: H.wagner, S.Bladt EM Zgainsti - Tram. Th. A Scott. - Springer-verlag Tokya 1984.

Paper VII - Physical Chemistry II (90 L)

Unit P - 501 Nuclear and Radiation Chemistry (21 L)

Nuclear ractions: Types, conservation, reaction cross-section, compound nucleus theory, specific nuclear ractions, photonuclear and thermonuclear reactions. Nuclear fission: fission process, fission fragments, mass and charge distribution, fission energy, theory of nuclear fission. Nuclear reactors.

Radiochemical techniques: Neutron activation analysis. Radiation chemistry: The interaction of radiation with matter - Processes responsible for energy loss, range, and range energy relations methods of detection and measurement of radiation. Elements of Physical and chemical radiation effects in solids, radiation chemistry of water and aqueous ferrous sulphate solution. Dosimetry.

References:

1. S Glasstone, Source Book on Atomic Energy.
2. J B Rajam, Atomic Physics.
3. Vanderwerf, Radioactive Isotopes.
4. Nuclear Chemistry and Its applications, M Haissinsky.
5. G Friedlander and J W Kennedy, Nuclear and Radio Chemistry.
6. N W T Spinks and R J Woods, An Introduction to Radiation Chemistry.

Unit P - 502 Photochemistry (9 L)

Experimental determination of Quantum Yield. Factors affecting quantun yield. Photochemical reactions: Dimerisation of anthracene, Hydrogen-Bromine reaction, Hydrogen - Chlorine reaction. Influence of temperature on Photochemical reactions, Photo reaction in solids such as silver halides. Principles of utilisation of solar energy - eg., solar cell (elementary ideas only).

Contd....

Luminescence: Photoluminescence, chemiluminescence, cathodoluminescence, electroluminescence, bioluminescence, Thersoluminescence, Fluorescence. Theory of fluorescence, Stokes, Antistokes and Resonance fluorescence. Sensitised fluorescence. Quenching of fluorescence.
Theory of quenching of fluorescence - Kinetics.

References:

1. F. Daniels and R A Alberty, 'Physical Chemistry', Wiley
2. S Glasstone, "Physical Chemistry", Van Nostrend
3. Gurudeep Raj and Harish Mehra "Photochemistry". Goel Pub. House.

503

Unit P - Chemical Kinetics (21 L)

Arrhenius theory, Collision theory and transition state theory. Significance of the various activation parameters. Theoretical calculation of the activation energy. A comparative study of the collision and transition state theories.

Kinetics of reactions involving reactive atoms and free radicals. Use of Rice Herzfeld mechanism and steady state approximation in arriving at rate laws of such reactions. Theories of unimolecular reactions. Kinetics of chain reactions. Branching of chain and explosion limits. Theories of general and specific acid and base catalysis - Simple enzymatic catalysis and heterogeneous catalysis. Kinetics of reactions in solution - role of solvent - effect of specific properties of the solvent - such as dielectric constant and dipole moment on rates of reactions between ions, dipoles and neutral molecules. Salt effect, primary and secondary kinetic salt effects. Study of the kinetics of simple fast reactions using relaxation time.

References:

1. K J Laidler 'Chemical Kinetics' Vol.I and II, Mc Graw Hill.
2. A A Frost and R J Pearson Kinetics and Mechanism John Wiley
3. F Daniels and R A Alberty, 'Physical Chemistry' Wiley.

Contd....

Unit P - 504 Statistical Thermodynamics (21 L)

a) Basic Principles (6 L)

Permutations. Probability distribution of particles in energy states. Micro states and macro states (configurations). Statistical weight. Most proable distribution. Boltzmann distribution law. The partition function and its relation to the thermodynamic functions.

b) The perfect gas (3 L)

Factorization of the partition function into the translational, rotational, vibrational and electronic parts. The corresponding contributions to the thermodynamic functions. The anomalous heat capacity - temperature relation for hydrogen: ortho and para hydrogen.

c) The Atomic Crystal (3 L)

The Einstein theory of atomic crystals. Debye's modification of the Einstein model.

d) Imperfect Gases (3 L)

The Virial expression and the virial coefficients. Relation between the virial coefficients and the cluster integrals.

e) The Ideal Fermi Gas (3 L)

Fermi-Dirac distribution law. Equation of state of an ideal Fermi gas. Limiting forms of the expression at

a) high emperature and low denstities
b) Low temperature and high densities
Application to electrons in metals.

f) The Ideal Bose gas (3 L)

The Bose-Einstein distribution law, Application to Bose-Einstein condensation. Application to liquid helium.

Contd.....

Reference:

1. Statistical Mechanics, G S Rush brooke, Oxford University Press.
2. An Introduction to Statistical Thermodynamics, T L Hill, Addison - Wesley.
3. Equilibrium statistical Mechanics, F C Andrew, John Wiley.
4. Statistical Mechanics, Thermodynamics and Kinetics, O K Rice, W H Freeman and Co.

Unit P - 505 Group Theory (18 L)

Mathematical group. Finite and infinite groups. Abelian And cyclic groups. Group multiplication table. Classes in a group. Similarity transformation. Symmetry elements and symmetry operations in molecules. Point groups and their systematic identification. Isomorphic groups.

Matrices and their addition and multiplication. Inverse of a matrix. Character of a matrix. Block diagonalization (mention). Matrix representation of symmetry operations. Reducible and irreducible representation. Notation for irreducible representation. The orthogonality theorem and properties of irreducible representations (proof not needed) Reduction formula, Construction of charecter tables C_{2v}.

Applications of group theory. Molecular vibrations (eg.H_2O) Tetrahedral hybridisation in CH_4 and Trigonal hybridisation in BF_3.

References:

1. F A Cotton, 'Chemical Application of Group Theory", Wiely Eastern.
2. Jaffa & Orchin, "Symmetry in Chemistry".
3. L M Mall, "Group Theory and Symmetry in Chemistry", M c Grew Mill.
4. V Ramakrishnan & M S Gopinathan, "Group Theory in Chemistry', Vishal Publication.
5. P K Bhattacherya, "Group Theory and Its Chemical Applications", Mimalaya Publishing House.

Practical VI - Physical Chemistry II (36 LS)

(A minimum of 15 experiments covering all the listed experiments shall be carried out for full credit).

Unit I - Chemical Kinetics (4 expts) (12 LS)

1. Acid hydrolysis of methyl acetate - Determination of specific reaction rats and concentrations of the given acids.
2. Acid hydrolysis of methyl acetate - Determination of Arrhenius parameters.
3. Saparification of ethyl acetate - Determination of specific reaction rats.
4. Iodination of acetone in acid medium - Determination of the order of the reaction with respect to iodine and acetone.

Unit II - Adsorption (2 expts) (6 LS)

1. Charcoal/acetic acid system: Verification of Freundlich and Langmnir adsorption isotherms. Determination of the concentration of a given acetic acid solution using the isotherms.
2. Charcoal/oxadic acid system: Verification of Freundlich and Langmnir adsorption isotherms. Determination of the concetnration of a given oxalic acid soultion using the isotherms.

Unit III - Phase Equilibrium (4 expts.) (12 LS)

1. a) Phase diagram of a simple eutectic system (naphthalene - biplemyl.
   b) Determination of the composition of a binary solid mixure.
2. Phase diagram of a binary solid system forming a compound.

3. a) Phase diagram (mutual solubility curve) of a ternary liquid system (Chlorform - acetic acid - water, Benzene-acetic acid - water.

Contd.....

b) Determination of the composition of a binary liquid mixture (Choloroform - acetic acid, benzene - acetic acid)

4. a) Phase diagram (mutual solubility curve) of a binary liquid system (Phenol - water) - The critical solution Temperature (CST).

b) Effect of impurities (Nacl, Salicylic acid Succinic acid) on CST.

£. Effect of an impurity (eg K cl) on the miscibility temperature of Phenol - water system and determination of the concetnration of the impurity.

Unit IV - Polarimetry (2 expts.) (6 LS)

1. a) Specific and molar rotations of glucose, fructure and sucrose.

b) Determination of the concentration of a glucose solution.

2. a) Inversion of cane sugar in presence of H Cl - Determination of the specific rate of the reaction.

b) Comparison of the strength of two solutions of H Cl.

Unit V - Spectrophotometry (2 expts) (6 LS)

1. Verification of Beer - Lambent law and determination of the concentration of a solution of $K_2Cr_2O_7$ (or $KMnO_4$

2. Determination of pK value of an acid-base indicator (Methyl Red).

3. Spectrophotometic titration (a) Fe^{3+} x EDT A (b) Cu^{2+} x EDTA (e) (Fe^{3+} + Cu^{2+}) x EDTA.

Unit VI - Chromatography (1 expt) (2 LS)

1. Determination of Rf value.

Paper VIII Elective: Analytical Chemistry (90 L)

Unit I: Evaluation of analytical data, significant figures, accuracy and precision, types of errors, standard deviation, statistical treatment of data, students T test, confidence limit, rejection of suspected values, Q test (10 L)

References

1. A Text book of Quantitative inorganic analysis, A I Vogel
2. Instrumental methods of analysis H H Willard, L L Merritt, (Jr), J A Dean, F A Settle, (Jr) Sixth edition, CBS publishers, 1986
3. Analytical Chemistry - An Introduction, D A Skoog and D M West, Fourth edition, CBS International edition, '86.

Unit II Basic Electronics (Basic concepts and applications only) (9 L)

Measurements of voltage current and resistance. Colour code, diodes and triodes rectifiers, transistors, amplifiers, VRVM - Linear integrated circuits, thermisters, digital electronics, piezoelectricity and pyroelectricity.

References:

1. Electronics for scientists, Malmstadt, Enke a Toren.
2. Principles of Electronic Instrumentation, A J Diefenderfer.
3. Electronic Devices, Circuits and Applications, K N Lakshminarayan.
4. Ref. 2 of Unit I

Unit III: Classical methods of analysis (10 L)

Acid-base, complexation and redox equilibria, titrations in non-aqueous solvents, selectivity in EDTA titrations - effect of P^H, masking precipitation equilibria - mechanism

Contd...

of precipitate formation, aging of precipitates, coprecipitation, post preciptation, homogenious precipitation, processing of precipitates
Common organic reagents used in gravimetry Oxine, cupferon, DMG, 1-nitroso-z-nabhthol.

Reference: Ref 1 of unit I
Ref 3 of unit I

Unit IV: Separation methods in analysis (15 L)

Solvent extraction - Quantitative treatment of solvent extraction equilibria, ion-association complexes, typical extraction reagents (acetylacetone, oxine, dithizon dithiocarbamate and crown ethers
Ion exchange - Action of ion exchange resins, chelating ion exchange resins, liquid ion exchangers chromatography - classification, Basic theory and detection, speration and analysis through paper, thin layer, column and ion exchange chromatography, GLC and HPLC

References

1. Ref.1, 2 and 3 of Unit I
2. Chromatography, E Lederer and M Lederer.

Unit V: Electroanalytical methods:
Basic theory, instrumentation and typical applications of electrogravimetry, coulometry, polarography and amperometry. Conductometric titrations. (15 L)

References

1. Ref. 1,2 and 3 of unit I
2. Electroanalytical Chemistry, J J Lingane.
   Willard, J A Dean.

Unit VI: Optical methods of analysis (15 L)

Basic theory, instrumentation and typical applications of

Contd.....

spectrophotometry, fluorimetry, nephelometry and turbidimetry atomic absorption spectrometry and atomic fluorescence spectroscopy.

References

Reference 1, 2 and 3 of unit I

Unit - VII

Thermal Analysis

Thermogravimetry, Differential thermal analysis, differential scanning calorimetry. Thermometric titrations.

References:

1. Thermal Methods of Analysis, W W Wendlandt.
2. Thermal Analysis, Vol. I, II a III, R F Schwenker (Jr) a P J Gram.
3. Ref 1 and 2 of unit I

Unit VIII: Radiochemical methods (5 L)

Applications of radionuclides, activation analysis

Reference

Ref. 2 of unit I

Unit X Research Methodology

Literalure survey, Planning of experimental work, seminars and discussion, preporation of thesis publication of research paper etc.

Paper VIII Elective (Environmental Chemistry)

Unit I : Environment - concept of environmental Chemistry Segments of environment - lithosphere - atmosphere - hydrosphere and bioshere. Lithosphere - soil, formation by physical, chemical and biological weathering. Composition of the soil. Atmosphere - composition, temperature and pressure changes, of troposphere, stratosphere mesosphere and ionosphere Hydrosphere - sea water and river water - composition - dissolved gases. Hydrologic cycle. Biosphere - Principles of ecology - shift of ecologic balance by human activities. Biogeochemical cycles - C, O, N, S & P cycles
Environmental Pollution - Pollutant, definition - origin, classification and types of pollution.

Unit II: Atmospheric pollution - Air pollution - sources industrial - automobiles-fate of air pollutants - Chemical reactions in the atmosphere movement of air pollutants - SO_2, NO_x, CO, H_2S, smoke, hydrocarbons, metal fumes, chlorine etc. - sources and their effecton human and plant systems. - acid rain - green house effect - smog and photochemical smog - CFC and ozone hole - photochemical reactions in the stratosphere.

air pollution control methods. Air quality standards
Air pollution incidents - Bhopal tragedy.

Unit III Wate pollution -

Water Pollution (15 L)

Sources of water pollution: Sewage, wastes from industries, tanneries, detergents, etc. Effects of pollutants: oxygen deficiency, toxicity and eutrophication.

Contd...2.

Normal level of dissolved oxygen in water for fish growth. Experimental determination of dissolved oxygen in water. Chemical oxygen demand (COD), and biochemical oxygen demand (BOD).

Metallic pollution: Minamata disaster.

Treatment of water: Water quality criteria for industrial and domestic uses. Sewage treatment, industrial waste water treatment, drinking water supplies. ISI standards for drinking water.

References:

1. Handbook of water Resources and Pollution Control, H W Gehm a J I Bergman (Eds).
2. Principles of Water Quality Control, T H Y Tobbutt.
3. Environmental Chemistry A K Do.

Unit IV: Soil pollution - Effect of fertilizers on soil utilization of agricultural wastes - gobar gas pesticides and herbicides - classification, reactivity, detection and measurement, thermal and photodecomposition in soil pesticide residues in soil.

Unit V: Solid wastes - classification - sources - disposal methods - sanitary landfill, incineration, composting aerobic and anaerobic reactions - vermiculture. recycling of plastics and other solid wastes

Unit VI: Radiation in the environment -

Radiation in the Environment.

Mode of radiation decay and its harmful effects in the environment. The nuclear fuel cycle. Transportation of radioactive materials. Radioactive waste management. Radio-nuclies in soil. Effects of Ionising radiation. Effects on eco-systems. Accidents in atomic plants: Chernobyl and Three mile island disasters. Methods of radiation protection.

Contd...3.

References::

1. Cleaning Our Environment - A Chemical Perspective, American Chemical Society, 1978, Chapter 8.
2. Radiation protection, J Shapiro.

Unit VII: Environmental Toxicology :-

Environmental Toxicology (9 L)

Chemical factors which influence toxicity. Toxicological testing methods. Acute, prolonged and chronic toxicities. Biological effects of arsenic, cadmum, lead, mercury, carbon monoxide and cyanide. Carcinogens.

Reference:

1. Essentials of toxicology, T A Loomis.
2. Industrial Toxicology, A Hanilton a H L Hardy.
3. Environmental Chemistry, A D De.

Unit VIII:-Analysis of pollutants - Sampling techniques of a air, water and soil samples analysis of SO_2, NO_2, CO, ozone . Determination of DO, COD, BOD, TOC, N & P monitoring methods.

Unit IX: Instrumental methods:

Instrumental Methods in Environmental Chemical Analysis (12 L)

(Principles of the Methods only)

a) Neutron activation analysis.
b) Anodic stripping voltammetry.
c) Atomic absorption spectrometry.
d) X-ray fluorescence.
e) Infrared spectrometry.

Contd...4.

f) Chemiluminescence.

g) Gas Chromatography/Mass spectrometry.

h) Ion-selective electrodes.

References:

1. Environmental Chemistry, A K De.
2. Instrumental Methods of Chemical Analysis.
G W Ewing.

Unit X: Research Methodology

Books:

1. Environmental Chemistry AK. De by B K Sharma &
2 " " Kaur
3. Environmental Central Engineering by C S Rao
4. Clearing the Environmental by American Chemical Society.

Paper VIII - Elective: Natural Products

Unit I Taxonomy of Plants

Location, identification, cultivation, collection, storage and uses of plants of medicinal importance.

References:

1. Gamble J S, Flora of the presidency of Madras. Vols. (1957 Edn.) Bot. Surv. of India, Culcutta.
2. Lwarence G H 1951 Taxonomy of Vascular plants 1974 Ed. New Delhi.
3. Rendle. A B 1934. The classification of flowering plants 1971 Edn Cambridge Univ. Press.
4. Hooker J D (1872-1897) The flora of British India. Vols. London.
5. Bailey L H 1949. Manual of cultivated plants (VIth refer 1961) Macmillan company. New York.
6. Jones, S B and A E Luchsinger 1979 plant systematics. Mc Grow Hill Inc. New York.

Unit II Classification of Natural products (3 L)

Carbohydrates, Terpenoids, Carotenoids, alkaloids, steroids, anthocyanins etc. Methods of isolation of each class of compound and detailed study of each class of compound and detailed study including structure elucidations, synthesis and stereochemistry under each class.

Unit III Terpenoids (18 L)

Classification of terpenes - isoprene rule - Ionones Carvones, Menthol, methone, a-Thujene car-3 one, car 2-one, Carone, Caronic acid. a-Pinene, Camphor, Farnesol, Bisabolene, Aristolechenone. Ishwarano, Ishwarone, Eremphilone, Abietic acid, squalene litsomentol Lupeol, a-amyrin, B-amyrin.

Contd.....

Unit VIII Biogenesis of Natural Products like terpene steroids and alkaloids (6 L)

References:

1. Bernfeld (ed) Biogenesis of Natural Products (1967).
2. Mulheirn and Ramm, The biosynthesis of sterols Chem Soc. Rev. 1972, 259.
3. Relevant chapters of I L Finar.

Unit IX Spectral application (I R., U V., N M R., Mass, C D and O R D) in the structural elucidation of Natural products. (12 L)

References:

1. Determination of organic structure by Physical Methods, Academic Press Vol. 1 to 4.
2. Schwarz (ed) Physical methods in organic Chemistry, Oliver and Boud (1964).
3. Djersassi, Optical Rotatory Dispersion Mc.Graw Hill.
4. Crabbe, Optical Rotatory Dispersion and Circular Dichroism in organic chemistry Holdern Day (1965).
5. William and Fleming, Spectroscopic methods in Organic chemistry Mc. Graw Hill (1966).
6. Bible, Interpretation of NMR spectra, Plenum Press (1965).
7. Nature 1968, 217, 918.

Unit X Haemin and Chlorophyll (6 L)

Structure and synthesis of Porphyrins, Chemistry of Haemin and Chlorophyll.

References:

1. Finar Vol.II.
2. Biochemistry by Leneingher.

Paper: VIII - Elective Polymer Chemistry (90 L)

Unit 1. Basic Concepts and Terminology. (5 L)

Fundamental concepts of polymer Science History and development of macromolecular concept. Importance in everyday life. Natural and synthetic polymers. Different types of polymers and polymerization procerses. Molecular Forces and Chemical bonding in polymers. Primary and secondary bond forces and intermolecular forces. Molecular weight and molecular weight distribution. Different types of molecular weights. Number average, Weight average land $\bar{Z}$ - average molecular weights.

Unit 2. Correlation Between structure and Physical properties. (4 L)

Basic determination of polymer properties. Solution properties and chemical nature and plymer chain. Effect of substitution on polarity and hydrogen bonding on polymer solubility. Melting properties and tensile strength. Glass transition temperature and crystallive melting point. Molecular interpretation of glassy state of polymers.

Unit 3: Step - Reaction (Condensation) Polymerization (4 L)

Classification of polymers and polymerization mechanisms. Mechanism of step - reaction polymerization. Kinetics of step polymerization. Polyfunctional step - reaction polymerization - Gelation and gel point.

Unit 4: Radical polymerization (Addition polymerization) (4 L)

Nature of Radical chain polymerization. Mechanism of vinyl polymerization. Kinetics of vinyl Radical chain polymerization. Molecular weights and its distribution. Effect of Temperature and pressure on radical chain polymerization.

Contd....

Unit 5: Ionic and Coordina chain (Addition) Polymerization (4

Similarities and comparison of radical and Ionic polymerization catiomic polymerization. Initiation, Propagation, chain transfer and Termination Mechanism. Kinetics. Effect reaction medium. Living polymerization. Anionic polymerization. Initiation, propagation, Termination, Kinetics - Mechanism. Coordination polymerization Mechanism - Kinetis. Ring opening polymerization - cyclic ethers, Lactams, Lactomes and introgar heterocyclics.

Unit 6: Copolymerization (5 L)

General considerations: Copolymer composition. Mechanism of copolymerization. Kinetics of copolymerization. Radical copolymerization and Ionic copolymerization. Block and gaaff copolymers. Ziegler - Natta Polymerization sterioochemistry.

Unit 7: Polymerization Processes: Polymerization in (5 L)

homogeneous and hetereogeneous systems. Gasphase polymerization. Bulk polymerization and polymer precipitation. Emulsion and suspension polymerization. Mono and heterodisperse polymers.

Unit 8. <u>Chemical Reaction of Polymers:</u> (5 hrs)

Reactivity of functional groups in polymers. Chemical modification of linear and cross-linked polymers. Polymer analogous reactions. Effect of cross-linking on the reactivity of functional groups. Functionalization of polystyrene. Preparation of ionexchange resins. Polymer-bound reggents. polymer-bound catalysts. Immobilized enzymes. Applications.

Contd.....

Unit 9: Measurement of Molecular weight and size: (10 hrs)

Methods of molecular weight determination of polymers. End-group analysis, Collective property measurements- concentration dependence of colligative properties vapour pressure lowering, cryoscopy and osmometry. Light scattering methods. Ultracentrifugation method and gelpermeation chromatography for determination of molecular sizes, solution viscosity and molecular sizes, - experimental methods, treatment of data, standinger index. Experimental correlation between intrinsic viscosity and molecular sizes.

Unit 10: Polymer Solutions: (8 hrs)

General rule of polymer solubility, Solubility parameters Flory-Huggins treatment of polymer solution. Enthalpy, entropy and free energy change in polymer dissolution. Unportubed chain dimension, viscosity of polymer solution, osmetic pressure, Swelling of polymers, phase separation in polymers.

Unit 11: Structure and Properties of Polymers (6 hrs.)

Studies on the thermal, opticalm electrical and mechanical properties of polymers, correlation of structure to these propertieses. First order and second order transition points, Experimental method of their determination.

Unit 12: Structure and Characterisation of Polymers. (4 hrs)

The use of X-ray Scattering and ultraviolet, infrared and NMR Spectroscopic methods in the determination of polymer structures. Gel permeation chromatography and other chomatographic techniques in the fractionation of polymers. Thermal characterization.

Contd....

Unit 13: Preparation, Structure and Applications of the following.

i) Cellulose & Cellulose based polymers - Native and modified Cotton, Rayon - Cellulose nitrate, Cellulose acetate.

ii) Polyolefins - Polyethylane - Low density and High density polypropylane.

iii) Vinyl polymers - PVC, polystyrene, acrylic polymers.

iv) Flurocarbon - Teflon.

v) Polymethane

vi) Phenol formaldelyde and urea formallely

vii) Polyamide (Nylons) and polyesters (Terylenes)

viii) Caprolactom based polymers.

ix) Silicones.

References:

1. G Odian, 'Principles of Polymorization'. McGraw Hill (1970).
2. F W Billmeyer, 'Text-book of Polymer Science' Wiley-Interscience (1976).
3. K J Saunders, 'Organic Polymer Chemistry' Capman and Hall, London (1973).
4. Elias 'Macromolecules' Plenum Press (1980).
5. Narang, Mathur and Williams, 'Polymers as aids in Organic Chemistry', Academic Press (1980).
6. H R Allocock and F W Lampe, 'Contemporary Polymer Chemistry', Prentice-Hill (1981).
7. R B Symour and C E Carraher, 'Polymer Chemistry', Marcel-Decker (1981).
8. G S Misra, 'Introductory Polymer Chemistry' Wiley Eastern (1993).