Annexure No.	**23 D**
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BHARATHIAR UNIVERSITY : COIMBATORE - 641 046

M.Sc. Chemistry Degree Course

(School of Distance Education)

(for the students admitted from the academic year 2007-2008 onwards)

Scheme of Examination

Year	Title of the Paper	Hrs	Max. marks
I - Year			
Paper - I	Organic Chemistry – I	3	100
Paper - II	Inorganic Chemistry – I	3	100
Paper - III	Physical Chemistry – I	3	100
Practical - I	Organic Chemistry – I	6	70
Practical - II	Inorganic Chemistry – I	6	70
Practical - III	Physical Chemistry-I	6	60
II-Year			
Paper - IV	Organic Chemistry – II	3	100
Paper - V	Inorganic Chemistry – II	3	100
Paper - VI	Physical Chemistry-II	3	100
Practical - IV	Organic Chemistry - II	6	70
Practical - V	Inorganic Chemistry - II	6	70
Practical - VI	Physical Chemistry - II	6	60
		Total	1000

PAPER I ORGANIC CHEMISTRY - I

Subject Description :
This contents of this paper present the basic principles of understanding mechanism of organic reactions. In addition to the general physical methods of approaching the course of reactions, specific examples like aromatic electrophilic substitution, aliphatic nucleophilic substitution, elimination and free radical reactions have been dealt with in detaiI. And also it gives a concise idea of concerted reactions, addition reactions, mechanism in organic photochemical reactions, elimination reactions and stereoisomerism in organic compounds.

Goals : To motivate and enable the students to comprehend the possible chemical route by which a reaction may proceed and learn pericyclic reactions. A comprehensive knowledge on conformational analysis is also aimed.

Objectives :
On successful completion of the course the students should have:
understood aromaticity, antiaromaticity and nonaromaticity in organic compounds,
learnt possible reaction pathways in aromatic electrophilic, aliphatic nucleophilic, elimination and free radical reactions.
mastered concerted reactions, Woodward-Hofmann rules, organic photochemistry, and stereoisomerism in organic compounds.

Contents:
UNIT-I
1. Aromaticity : Introduction - Aromaticity of benzenoids and heterocyclic compounds. Non-benzenoid aromatics - annulenes. Azulenes and ferrocenes(synthesis not necessary). Antiaromatic and non aromatic compounds.
2. Kinetic and nonkinetic methods of study of reaction mechanisms - Kinetic methods primary and secondary kinetic isotopic effects, non-kinetic methods - study of reaction mechanism — study of intermediates, isotopic labeling, stereochemical studies and cross over experiments. Hammond's postulate. Kinetic and thermodynamic control.
3. Linear free energy relationship — Hammett equation (Taft equation not necessary).

UNIT—Il
Aromatic electrophilic substitution. reactions – Introduction - Mechanism of electrophilic substitution. reactions such as halogenation, nitration, sulphonation and Friedel – Crafts alkylation and acylation reactions. Orientation and reactivity. Electrophilic substitution on monosubstituted and disubstituted benzenes. Typical reactions such as Gattermann reaction Gattermann Koch reaction. Rimer Tiemann reaction. Kolbe reaction. Hofmann-Martius and Jacobson's reactions.

UNIT-III
Aliphatic nucleephilic substitution reactions & mechanisms:
SNI, SN2, SNi mechanisms. Factors affecting nucleephilic substitution reaction – nature of the substrate, solvent, nucleophile and leaving group. Neighbouring group

participation. Ambident nucleophiles and ambident substrates. Stereochemistry of nucleophilic substitution reactions. Substitution at vinyl carbon allylic carbon and bridge head carbon. Typical substitutions such as Von Braun reaction, Claisen condensation and hydrolysis of esters.

UNIT- IV

Elimination reactions: El, E2, Ei, E1CB mechanisms, Stereochemistry of elimination reactions. Elimination Vs substitution. Typical elimination reactions such as Chugaev reaction. Hofmann degradation. Cope elimination.

Carbenes and nitrenes — structure, generation and reactions.

UNIT-V

Free radical reactions: Introduction -structure, stability and geometry of free radicals. Generations of long lived and short lived free radicals. Characteristics of free radical reactions - substitutions - additions and eliminations, rearrangements. of free radicals. Typical reactions such as Sandmeyar, Gamberg, Pechmann, Ullman, Pschorr and Hunsdiecker reactions.

UNIT-VI

1. Additon reactions : Eelectrophilic and nucleophilic. Addition to double and triple bends — Hydration. hydroxylation. Michael addition. hydroboration and apoxidation.
2. Addition to carbonyl compounds : Mannich reaction, Dieckmann, Stobbe, Knovenagel, Darzen, Wittig, Thorpe and Benzoin reactions.

UNIT—VIl

Concerted reactions: Pericyclic reactions — the perturbation theory of pericyclic reactions, the electrocyclic reactions & sigmatrophic reactions, the woodward — Hofmann rules, orbital correlation diagrams, the frontier orbital theory. Cycloadditions - Diel's Alder reaction. Cope, Claisen and Di-pi - methane rearrangements.

UNIT - VIII

Stereoisomerism – Configurational & conformational isomerism**:**

Introduction, definition & classification. Molecular representation (Fischer projection, Newmann projection formula). Basic requirements of optical isomerism. Optical isomerism exhibited by a few nitrogen and sulphur compounds – the role of nitrogen inversion.

Configurational nomenclature: D & L, R & S and E & Z(olefins) nomenclatures.

Conformations of acyclic and cyclic molecules:

Conformations of ethane and 1, 2 disubstituted ethanes. Configurations and conformations of cyclohexane, mono and disubstituted cyclohexanes(conformational equilibrium – delta G). Configurations and conformations of fused polycyclic systems – decalin, perhydrophenanthrene, perhydroanthracene.

REFERENCES

I. Jerry March — Advanced organic chemistry
2. I.1. Finar — Organic chemistry. Vol. 1 & II
3. R.T. Morrison and R.N. Boyd — Organic chemistry
4. E.S. Gould — Mechanism and structure in organic chemistry
5. E. R. Alexander — Principles of ionic organic reactions
6. Fieser and Fieser — Advanced organic chemistry
7. J.B. Hendrickson, D.J.Gram and G.S.Hammond — Organic chemistry
8. P.J. Garrat — Aromaticity
9. Badger — Aromaticity and aromatic character
10. D.V. Banthorpe — Eliminations
II. L.N.Ferguson — The modern structural theory of organic chemistry
12. C.A.Buntcn -- Nucleophilic substitution at the saturated carbon atom
13. J .Miller -— Atomic nucleophiclic substitution
14. C.K. lngold — Structure and mechanism in organic chemistry
15. K.Milson — Introduction to stereochemistry
16. LL.Lliel — Stereochemistry of carbon compounds
17. Whitaker David — Stereochemistry
18. Eliel and Ailsinger — Stereochemistry
19. Jaffee and Drchin : Orbital symmetry
20. Entwistle : Orbital symmetry correlations in organic chemistry
21. Lehr and Marchand : Orbital symmetry
22. Pant Dc Mayo : Molecular rearrangements vol. 1 & II
23. N.J. Turro : Molecular photochemistry
24. C.H. Depuy and O.S. Chapman : Molecular reactions and photochemistry
25. J.M. Coxon and B.Halton : Organic chemistry
26. W.A. Pnyer : Introduction to free radical chemistry
27. S.M.Munergee and S.P.Singh : Reaction mechanisms in organic chemistry

Paper II - INORGANIC CHEMISTRY - I

Subject Description :

This paper presents an idea about inorganic ring systems and clusters. Some basic concepts of solid state chemistry.

Goals : To enable the students to learn some principles and theories in inorganic and solid state chemistry.

Objectives :

On successful completion of the course the students should have an exposure to the nano technology.Basic idea about the properties of solids

Contents

UNIT – I

Inorganic rings – chains – cages and clusters – metal clusters – dinuclear, trinuclear, tetra nuclear and hexa - nuclear clusters – organometallic clusters.

UNIT – II

Borazines – phosphonitrilic compounds – sulpher - nitrogen ring compounds.Metallic state – free electron and band theories – non stochiometry – point defects in solids – Schotty - Frenkel defects – linear and dislocation effects.

UNIT – III

Electrical properties of solids – superconducting elements – critical temperature – persistent currents – thermoelectric properties – magnetic properties (perfect diamagnetism) – Meissner effect

UNIT – IV

Nuclear chemistry-the nuclues-subatomic particles and their properties –binding energy- N-P ratio in stable and metastable nucluei-different types of nuclear forces-liquid drop model-shell model-mode of radioactive decay

UNIT – V

α,β,γ decay-electron capture-nuclear isomerism-internal converstion.Nuclear reactions Q-value, coulombic barrier, cross section, different types of nuclear reactions-projectiles capture – particle emission, spallation.

Unit VI

Fission fusion-theories of fission, use of fission products, fissile and fertile isotopes – U^{233}, U^{235}, Pu^{239}, Th^{232}, - atomic power projects in India, stellar energy, synthetic elements – application of radio isotopes-hot atom chemistry.

Unit VII

Experimental methods:cloud chamber, nuclear emulsion, bubble chamber, proportional counters-G.M.., scintillation counters.

Particle accelerators-cyclotron, synchrotron, betatron., bevatron.

UNIT – VIII

Thermal analyses – TG – DTA – principle and instrumentation – Auger electron spectroscopy (AES) – UV photoelectron spectroscopy (UPS/PES) – principles and applications.

References :

Cotton and Wilkinson : Advanced inorganic Chemistry, Wiley Eastern (P), Ltd., 1968
Gurdeep and Harish : Advanced inorganic Chemistry, Geol Publishing House
G.M.Arora : Solid State Chemistry
R.A.Alberty and Silbey : Solid State Chemistry
J.P.Srivastava : Elements of Solid State Physics
Glasstone : Source book of

PAPER III - PHYSICAL CHEMISTRY - I

UNIT - I

Symmetry elements and symmetry operations: definition of identical and equivalent elements - configurations-symmetry operations and symmetry elements - rotation-axis of symmetry- reflections-symmetry planes-inversion center-improper rotations-rotation-reflection axis-effect of performing successive operations (commutative and non - commutative) - inverse operations.

Groups and their basic Properties: Definition of a group - basic properties of a group-definition of Abelian group-isomorphic group-similarity transformation and classes-group multiplication tables - symmetry classification of molecules into point groups (Schoenflies symbol only) difference between point group and space group.

UNIT-II

Definition of reducible and irreducible representations-irreducible representations as orthogonal vectors-direct product rule-the great orthogonality theorem and its consequences (statement only proof not needed)-determinations of the characters for irreducible representation of C2v and C3v point groups using the orthogonality theorem-calculation of binary co-ordinates in the character tables for C2v and C3v point groups—calculation of character values of reducible representations per unshifted atom for each type of symmetry operation-determination of total Cartesian representation—determination ot direct sum from total Cartesian representation.

Group theory and vibrational spectroscopy-vibrational modes as basis for goup representation- symmetry selection rules for IR and Raman spectra (mutual exclusion principle)-classification of vibrational modes.

UNIT – III

1. The time-dependent and time-independent schrodinger equations — Born's interpretation of the wave function. Requirements of the acceptable wave function.

2. Algebra of operators. Sums and products of operators. Commutator. Linear operators. Eigen functions and eigen values. Correspondence between physical quantities in classical mechanics and operators in quantum mechanics. Hamiltonian operator. Angular momentum operator. Quantization of angular momentum and its spatial orientation. Average (expecation) values. Postulates of quantum mechanics.

UNIT-IV

1. Particle in a one—dimensional box. Quantization of energy. Normalization of wave function. Orthogonality of the particle in a one—dimensional box wave functions. Illustration of the uncertainty principle and correspondence principle with reference to the particle in a one dimensional box. Particle in a three-dimensional box. Separation of variables.

2. Solving of Schrodinger equation for the one—dimensional harmonic oscillator. Harmonic oscillator model of a diatomic molecule. Illustration of the uncertainty principle and correspondence principle with reference to harmonic oscillator.

3. Solving of Schrodinger equation for a rigid rotor. Rigid rotor model of a diatomic molecule.

UNIT-V

1. Schrodinger equation for the H-atom (or H-like species) separation of variables (solving of radial equation is not needed but nature of solution is given), energy levels. Radial factors of the H-atom wave functions. Orbitals and orbital shapes. Probability density and radial distribution functions. The most probable distance of the H-atom (or H-like species) 1S electron.

2. Need for approximation methods. The perturbation theory (first order only). Application of the perturbation method to He-atom.

3. The variation method. Application of variation method to He-atom.

UNIT-VI

Themodynamics and Non-ideal systems: Chemical potential and the definition of fugacity. Determination of fugacity of gases by graphical method and from equations of state. Variation of fugacity with temperature. Fugacity and the standard state for non - ideal gases.

Definition of activity. Activity coefficient. Temperature coefficient of activity. Standard states. Applications or activity concept to solutions. The rational and practical approaches. Measurement of activity of solvent from colligative properties. Determination of activity of solute.

Third Law of Thermodynamics: Probability and third law. Need for third law. Nernst heat theorem and other forms stating third law. Thermodynamic quantities at absolute zero. Statistical meaning of third law and apparent exception.

UNIT-VII

Quantum statistics: Maxwell - Boltzmann statistics. Thermodynamic probability. Thermodynamic probabilities of systems in equilibrium. Boltzrnann expression for entropy. Stirling's approximation. States of maximum thermodynamic probability. Legrangian multipliers, thermodynamic probabilities of systems involving energy levels. Maxwell - Boltzmann distribution law. Evaluation of alpha and beta in M.B. distribution law. Partition function: Partition function - definition, justification of nomenclature, microcanonical and canonical ensembles. Molecular partition function and canonical function. The relation between the total partition function of a molecule and the separate partition functions.

UNIT-VIII

'Translational partition function, rotational partition function. Effect of molecular symmetry on rotational partition function. Ortho and para hydrogen. Vibrational partition function. Electronic partition function.

Heat capacities of solids: Einstein's and Debye's theories of heat capacities of solids.

Bose-Einstein and Fermi-Dirac Statistics: Bose-Einstein distribution law. Entropy of Bose- Einstein gas. Plank distribution law for black-body radiation. Fermi - Dirac distribution law. Entropy of a Fermi-Dirac gas.

REFERENCES:

1. M. Orchin and H.H. Jaffe	:	Symmetry, Orbital and spectra
2. G. Davidson	:	Introductory Group theory for Chemists
3. F.A.Cotton	:	Chemical applications of Group theory
4. Ira.N.Levine, Allyn & Bacon IC	:	Quantum Chemistry, 1 974
5. Mc. Quarie	:	Quantum Chemistry
6. Ira.N.Levine, McGrav	:	Physical Chemistry, Hill Book
7. Ira.N.Levine, Wiley	:	Interscience, N.Y. 1975
8. Klotz	:	Chemical thermodynanics
9. P.W.Aikins	:	Physical chemistry
10. S. G lassione	:	Thermodynamics
11. M . C. Gupta	:	Statistical thermodynamics
12. Lee. Sears and Salinger	:	Statistical thermodynamics

PAPER IV - ORGANIC CHEMISTRY - II

(Organic Synthesis and Natural Products)

Subject Description :

This paper gives a concise idea of molecular rearrangements, organic photochemistry, oxidation-reduction reactions, organic synthesis and synthetic reagents. This paper deals with chemistry of natural products – terpenoids, steroids, alkaloids, proteins and heterocyclic compounds.

Goals :

To enable the students to know molecular rearrangements, organic photochemistry organic synthesis and synthetic reagents, the chemical compositions of natural substances around them and to motivate them device synthetic routes to prepare natural products in the laboratory.

Objectives :

On successful completion of the course the students should have:
mastered rearrangement reactions, Woodward-Hofmann rules, organic photochemistry, synthetically important name reactions in organic chemistry and synthetic reagents.
understood the composition of the important natural materials around them.
learnt scientific methods to synthesise organic natural products.

Contents

UNIT - I

Molecular rearrangements: Introduction - Wagner - Meerwein rearrangements, Neber rearrangement, Baeyer — villiger rearrangement. Rearrangements to electron deficient nitrogen and oxygen — Dienone phenol, Favorski, Fries, Wolt Benzidine and Stevens rearrangement.

UNIT - II

1. Organic photochemistry: Introductory theory of light absorption, photophysical processes, energy transfer photochemical reaction of ketones Norrish type I and type II reactions. Paterno – Buchi reaction and cis and trans isomerisation.
2. Oxidation and reductions: Mechanisms — aromatisation, oxidation of olefins, alcohols and glycols,
ozonolysis,aromatization reaction and Sommelet reaction. Reduction reactions and selectivity in reduction. Reduction reactions involving metal hydrides($LiAlH_4$ and $NaBH_4$). Reduction of nitro compounds, carbonyl compounds and aromatic compounds. Typical reactions such as Birch reduction, Clemmensen, Wolff – Kishner and MPV reduction.

UNIT – III

1. Reactions and reagents: Reactions in organic synthesis: Oppanauer oxidation, Barbier – Wieland degradation, Barton reaction, Jones oxidation and Vilsmeier reaction.

2. Preparations and synthetic applications of DDQ(2,3-dichloro-5,6-dicyano-1,4-benzoquinone),DBU(1,5-diazabicyclo[5.4.0]undecene-5), CC(dicyclohexylcarbodiimide and crown ethers.

UNIT-IV

Terpenes: Isolation and classification of terpenes — structural eIucidation and synthesis of zingiberene. eudesmol. juvenile hormone. abeitic acid and caryophyllene.

UNIT-V

Steroids: Introduction — structural elucidation and synthesis of cholesterol, ergosterol, equilenin, estrone, testosterone and progesterone.

UNIT-VI

Alkaloids: Introduction – Introduction, isolation of alkaloids, structural elucidation and synthesis of morphine, reserpine. quinine. Atropine and glaucine.

UNIT-VII

1. Proteins and nucleic acids: Classification and characteristics(structure) of proteins — synthesis of polypeptides and oxytocin, enzymes and coenzymes. Structure of RNA and DNA and their biological importance.
2. Heterocyclic compounds: Structure, synthesis and reactions of flavones, isoflavones, purines (Adenine and Guanine) and anthocyanins (Cyanin and Pelargonin).

UNIT – VIII

Mass spectroscopy and circular dichroism.

1. Principles of mass spectrometry - presentation and analysis of spectra-determination of molecular formulae-nitrogen rule-isotope abundance analysis-meta stable ions and peaks-the molecular ion peak-fragmentation processes-symbolism (scission only)-even and odd electron ions- double bond and or ring equivalents implied from a formula.
2. Applications of mass spectroscopy - Scission with rearrangement – retro Diels-Alder rearrangement – McLaffertty rearrangement –-fragmentation associated with functional groups - aldehydes and ketones-carboxylic acids, esters, amides, alcohols - aliphatic compounds - aromatic compounds
3. Circular dichroism and optical rotatory dispersion-basic principles-basic principles of O.R.D. and C.D.-cotton effects-Octants rule-axial halo ketone rule-application of O.R.D. and C.D.

REFERENCES

I. J.L. Finar : Organic chemistry Vol. I & II
2. O.P.Agarwal : Natural product chemistry
P.S.KaIsj : Chemistry of natural products
R.K.Mackie and D.M.Sjnjti1 : Guide book to organic synthesis
J.N.Guntu and R.Kapoor : Organic reactions and reagents
Acheson : Introduction to heterocyclic compounds
Katritsky : Principles of heterocyclic chemistry
S. W.PejJeLjez. : Alkaloids

Paper V - INORGANIC CHEMISTRY - II

Subject Description :

This paper presents an idea about inorganic ring systems and clusters. Some basic concepts of Coordination Chemistry.

Goals :

To enable the students to learn some principles and theories in inorganic and Coordination Chemistry.

Objectives :

On successful completion of the course the students should have an exposure to the nano technology.Basic idea about the properties of solids

Contents

UNIT – I

Methods of preparation of coordination compounds – crystal field theory – spectrochemical series – molecular orbital theory – pi- bonding – magnetic behavior of the transition metal ions.

UNIT – II

Term symbols for the 3d-block elements and their ions – Orgel diagram – Tanabe-Sugano diagram for Co^{3+} system – John-Tellar distortions – spin-orbit coupling – Nephelauxetic effect – charge transfer spectra.

UNIT –III

Metal carbonyls – methods of preparation – properties and structure of Iron carbonyls – carbonyl halides – Vasca's compound – Zeise salt – Structure – hemoglobin – myoglobin - cyanocobalamine – chlorophyll (structure and functions).

UNIT –IV

Substitution reactions in square planar and octahedral complexes – trans effect – redox reactions Homogeneous catalysis by coordination compounds – hydroformylation – carboxylation of methanol – hydrogenation of unsaturated organic compounds.

Unit –V

Complexes of molecular nitrogen and oxygen.

Nitrosyl complexes, b-diketones, cyanide and isocyanide complexes.

Complexes of unsaturated hydrocarbons – alkenes, allyl and dienyls.

UNIT – VI

Carbocyclic pi complexes: Cyclopentadienyl and related complexes (synthetic, bonding, structure and reaction).

Arene complexes: Complexes formed by seven and eight membered aromatic rings.

Complexes of biochemical importance: Cytochromes, hemoglobin, mycglobin, cyanocobalmine, chlorophyll (structure and functions).

UNIT –VII

Building bridges between inorganic and organic chemistry – fragments – the isolobal analogy – structural implications of the isolobal analogy – the relationship between ML_n and ML_{n-2} fragments - from inorganic to organic chemistry – from organic to inorganic reaction mechanisms – beyond the octahedron.

Unit-VIII

HPLC – principle and application in chemical analyses
Diffraction methods – X-ray, electron and neutron diffraction - principle and instrumentation.

References :

Cotton and Wilkinson : Advanced inorganic Chemistry, Wiley Eastern (P), Ltd., 1968
Gurdeep and Harish : Advanced inorganic Chemistry, Geol Publishing House
G.M.Arora : Solid State Chemistry
R.A.Alberty and Silbey : Solid State Chemistry
J.P.Srivastava : Elements of Solid State Physics
P.Santhanaragavan and P.Ramasamy : Crystal Growth, Process

PAPER VI - PHYSICAL CHEMISTRY-II

UNIT-I

Theories of reaction rates: Arrhenius theory. Hard - sphere collision theory of gas - phase reactions. Activated complex theory or absolute reaction rate theory(ARRT) for ideal gas reactions (in terms of partition functions). Relation between activated - complex theory and hard - sphere collision theory. Thermodynamic formulations of activated complex theory & kinetic isotopic effect.

UNIT-II

1. Reactions in solution: Comparison between gas-phase and solution reactions. The influence of the solvent on the reactions between ions. Influence of ionic strength on rates of reactions in solution - Primary salt effect.

Influence of pressure on rates of reactions in solution Significance of volume and entropy of activations.

2. Study of Fast reactions: Flow methods, pulse methods, relaxation methods, Shock-tube method & nuclear magnetic resonance method.

UNIT-III

1. Homogeneous catalysis: Specific and general acid - base catalysis. Bronsted catalysis law. Hammett acidity function. Enzyme catalysis (single substrate reaction only). Michaelis-Menton law. Influence of pH and temperature on enzyme catalysis.
2. Surface phenomenon and heterogeneous catalysis: Adsorption and free energy relation at interfaces. Gibb's adsorption isotherm. Physisorption and chemisorption. Adsorption isotherms (Freundlich & Langmuir). Kinetics of heterogeneous catalysis. Langmuir - Hinshelwood and Langmuir - Rideal - Eley mechanisms.

UNIT -IV

1. Interionic attraction theory: Debye — Huckel — Onsager equation. Falkenhagen effect. Wien effect. Activity and activity coefficient. Ionic strength. Debye — Huckel limiting law and its applications.
2. Theories of double layer. Helmholtz — Perrin - Gouy chapmann — Stern theories.

UNIT-V

1. Polarography: Current — voltage relationships. The dropping mercury electrode. Diffusion current. Half— wave potentials. Applications of polarography. Amperometric titrations.
2. Fundamental principles of coulometric methods. Constant current and controlled potential methods. Simple applications.

UNIT-VI

Circular dichroism and optical rotatory dispersion-basic principles-basic principles of O.R,D. and C.D.-Cotton effects-Octant rule-axial halo ketone rule-application of O.R,D. and C.D.

Turbidimetry and Nephelometry-applications.

Thermal analysis: Differential thermal analysis (DTA) and differential scanning calorimetry (DSC)basic principles-thermo gravimetric analysis.

UNIT-VII

Electron spectroscopy:

ESCA (XPS): principle, chemical shifts-description of SCA spectrometer, X-ray sources, sample analysis, detectors and recording devices-applications.
Auger electron spectroscopy (AES) and ultra-violet photo electron spectroscopy (UPS/PES)-principles and applications.

Chromatography:

Theory, instrumentation and applications in the chemical analysis of the following:
GLC and HPLC

UNIT-VIII

Chemical crystallography:

Neutron diffraction and Electron diffraction.
X-ray diffraction-an elementary discussion of structural factors-Fourier synthesis and analysis.
Structure of rutile, fluorite and antifluorite, zinc blend, wurtzite, diamond and graphite.

REFERENCE:

1. A. I Vogel : A text book of quantitative inorganic analysis
2. 0. D. Christian : Analytical chemistry
3. D. A. Skoog and D. M. West : Fundamentals of Analytical Chemistry
4. D. A. Skoog : Instrumental methods of analysis
5. B. K. Sharma : Instrumental methods of analysis
6. H. H. Willard, L.L.Merrit, J.A. Dean: Instrumental methods of analysis
7. S.N.Khopkar : Fundamental concepts of Analytical Chemistry
8. K.J. Laidler : Chemical kinetics. Tata McGraw Hill
9. Gurdeep Raj : Chemical kinetics. Goel Publishing House
10. Pun, Sharma & Pathania : Principles of Physical Chemistry
11. A. A. Frost & R. G. Pearson : Kinetics and Mechanism. Wiley Eastern, Pvt
12. S. Glasstone : Introduction to electrochemistry.

PRACTICAL SYLLABUS

Practical – I Organic Chemistry – I

Analysis of two component – component mixtures. Separation and characterization of compounds.

About ten preparations involving one or two or three stages comprising of the following processes: Nitration, acylation, halogenation, diazotisation, rearrangement, hydrolysis, reduction, alkylation and oxidation and preparations illustrating the following: Benzoin condensation, Cannizzaro reaction, Perkin reaction, Reimer-Tiemann reaction, Sandmeyer reaction, Fries rearrangement, Skraup synthesis.

Note: A minimum of six organic mixtures should be analysed by each student. A minimum of ten preparations involving one or two stages should be done by each student.

Practical – II Inorganic Chemistry – I

Qualitative analysis, employing semimicro methods and spot tests of mixtures of common cations and ions of the following less familiar elements.

Thallium, Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, Titanium, Zirconium, Vanadium, Beryllium, Uranium and Lithium.

About ten preparations involving different techniques selected from the following:

Lead tetra acetate, dipyridinium hexachloroplumbate, hydroxylamine hydrochloride, ortho-and para-hydroxy phenyl mercuric chloride, potassium cupric

chloride, chrome alum, copper(I) chloride, trithio urea copper(I), potassium trioxalato-aluminato(III), potassium trioxalato chromate(III), potassium trioxalato ferrate(III), hexamine cobalt(III) chloride, chloro pentammine chromium(III), chloro aquo pentammine chromium(III) nitrate, tetrammine copper(II) sulphate, ammonium hexachloro stanate(IV).

Note: A minimum of six inorganic mixtures, each of two common and two rare elements should analysed by a student. A minimum of six preparations should be done by a student.

Colorimetric estimations (using Nessler technique and colorimeters) of copper, iron, nickel, manganese, chromium and zirconium.

Practical – III Physical Chemistry – I

Thermodynamics:

a. Heat of solution from solubility
b. Heat of solution by calorimetry

Molecular weight determination by

i. Freezing point depression of solvents (benzene and water) by Beckmann method.
ii. By Rast micro methods

Distribution of activity and activity co-efficients by freezing point method.
Distribution co-efficient and determination of equilibrium constant.

Properties of matter
Variation of viscosity of liquids with temperature.
Determination of refractive index (Unknown composition of a mixture of liquids).
Heterogenecus equilibria
Thermal analysis of binary systems forming compounds with congruent melting points.
Three component systems (chloroform-acetic acid-water).

Electromotive force
Determination of standard potentials (Cu, Zn, Ag)
Evaluation of thermodynamic quantities from e. m. f. data (Daniel cell).
Determination of PH and Pka values using hydrogen and quinhydrone electrodes and glass electrode (PH meter), potentiometric acid-base titrations.
Determination of formal redox potential of a redox system, redox titrations.
Determination of instability constant (of silver ammonia complex) and its dependence on temperature.
Determination of solubility product of a sparingly soluble salt (concentration cell and chemical cell).
Determination of activity co-efficients from e. m. f. data.
Precipitation titration of a mixture of halides.

Practical – IV Organic Chemistry – II

Estimation of phenol, methyl ketone, glucose, nitro, amino and methoxy groups, unsaturation.

Analysis of oils (Reichart – Meisel value, Iodine value, Saponification value and acetyl value).
Extraction and estimation of active constituents:
a. Lactose from milk b. Caffeine from tea c. Nicotine from tobacco extract d. Citric acid or ascorbic acid from a tablet or from a natural source.
About five preparations from literature.

Practical – V Inorganic Chemistry – II

Industrial analysis: a. Analysis of two of the following alloys – brass, bronze, stainless steel, solder type metal. B. Analysis of any one of the following – cement, dolomite, glass.
Titrimetry: Oxidation using ceric and vanadium salts: Complexometric titrations involving estimation of calcium, magnesium, nickel, zinc and hardness of water.
Chromatography: Column, paper, thin layer and ion exchange.
Titrations in non-aqueous solvents.
Preparation, analysis and study of the properties of co-ordination complexes.

Note: Quantitative analysis (involving volumetric and gravimetric estimations) of at least five mixtures of cations should be done by a student. The volumetric procedure may also include EDTA titration for estimation of mixtures of cations.

Practical –VI Physical Chemistry – II

Conductivity experiments:
Determination of i) Equivalent conductance of a strong electrolyte and the verification of Debye-Huckel Onsagar law. ii) Verification of Ostwald dilution law and kohlrausch law for weak electrolytes.
Conductometric determination of Pka of a weak acid.
Hydrolysis constant of aniline hydrochloride.
Determination of the solubility of a sparingly soluble salt.
Conductometric titrations: Acid-base and precipitation titrations (including mixture of halides).
Colorimetric estimation using Beer-Lambert law (copper, nickel).
Dropping mercury cathodes – half-wave potentials and estimations by differential method of cadmium, copper, zinc and lead.
Chemical kinetics:
i. Evaluation of Arrhenious parameters using acid hydrolysis of an ester.
ii. Base catalysed hydrolysis of an ester conductometrically.
Rate of reaction between persulphate and iodide ions study of salt effects over the persulphate – iodide reaction.
Study of rate of polymerization of monomer solutions by viscosity.
Evaluation of i) Catalytic constant of a strong acid for the iodination of acetone or hydrolysis of an ester.
ii) Catalytic constants for weak acids and verification of Bronsted catalysis law.
Adsorption experiments: Adsorption of oxalic, acetic, formic acids on activated charcoal – Freundlish isotherm – surface are determination.

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