

**MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI**

UG COURSES – AFFILIATED COLLEGES

B.Sc. Chemistry

(Choice Based Credit System)

(with effect from the academic year 2016-2017 onwards)

(44th SCAA meeting held on 30.05.2016)

Sem	Pt I/II/ III/IV V/VI	Sub No.	Subject status	Subject Title	Hrs / wee k	Cre dits	Marks				
							Maximum			Passing minimum	
							Int.	Ext	Tot.	Ext	Tot.
V	I	33	Core - 7	Organic Chemistry - III	4	4	25	75	100	30	40
	II	34	Core - 8	Physical Chemistry - III	4	4	25	75	100	30	40
	III	35	Elective - 1	Polymer Chemistry / Bioinorganic Chemistry	5	5	25	75	100	30	40
		36	Elective - 2	Analytical Chemistry/ Pharmaceutical Chemistry	5	5	25	75	100	30	40
		37	Practical -5	Gravimetric Estimation & Inorganic preparation	3	-	50	50	100	20	40
		38	Practical - 6	Organic Analysis & Organic preparation	3	-	50	50	100	20	40
		39	Practical - 7	Physical Chemistry experiments	2	-	50	50	100	20	40
	IV	40	Skill Based subject (Common)	Personality Development / Effective Communication	4	4	25	75	100	30	40
				Subtotal	30	22					

VI	I	41	Core - 9	Inorganic Chemistry - III	6	4	25	75	100	30	40
	II	42	Core - 10	Organic Chemistry - IV	6	4	25	75	100	30	40
	III	43	Core - 11	Physical Chemistry - IV	5	4	25	75	100	30	40
		44	Elective - 3	Green Chemistry/ Nano Chemistry	5	5	25	75	100	30	40
		45	Practical - 5	Gravimetric Estimation & Inorganic preparation	3	4	50	50	100	20	40
		46	Practical - 6	Organic Analysis & Organic preparation	3	4	50	50	100	20	40
		47	Practical - 7	Physical Chemistry experiments	2	4	50	50	100	20	40
				Subtotal	30	29					

ORGANIC CHEMISTRY-III

UNIT - I OPTICAL ISOMERISM

Representation of molecules in saw horse, Fischer, flying-wedge and Newman formulae and their inter translations.

Symmetry elements - chirality – asymmetric molecules and molecular dissymmetry-pseudo asymmetry.

Optical rotation – specific rotation –optical purity – racemisation (through cationic and anionic and radicalintermediates), resolution of acids, bases and alcohols via diastereomeric salt formation.

Optical isomers - enantiomers – diastereomers – epimers - notation of optical isomers - Cahn-Ingold-Prelog rules, R and S notations for optical isomers with one and two asymmetric carbon atoms - erythro and threo representations - D and L representations

Optical activity in compounds without asymmetric carbon atoms namely biphenyls, allenes and spiranes. Stereo selectivity – stereo specificity – partial asymmetric synthesis.

point,dipolemoment – chemical method – dehydration and cyclisation.

UNIT -II GEOMETRICAL & CONFORMATIONAL ISOMERISM

Geometrical isomerism – nomenclature of geometrical isomers – cis – trans ,E-Z notation and syn-anti for C=C,C=N compounds. Methods to assign configurations.

Stability of geometrical isomers and heats of hydrogenation.

Conformation: Conformational nomenclature - eclipsed, staggered, gauche and anti; dihedral angle, torsion angle, energy barrier of rotation – potential energy diagram. Relative stability of conformers on the basis of steric effect, dipole-dipole interaction, H-bonding;

Conformational analysis of ethane, propane, n-butane, haloethane, 1,2-dihaloethane, 1,2-glycol and 1,2-halohydrin, cyclopentane, cyclohexane and mono substituted cyclohexanes.

UNIT - III AROMATICITY & AROMATIC SUBSTITUTION

Aromaticity – definition – Huckel’s rule – consequence of aromaticity – stability, carbon-carbon bond lengths of benzene, resonance energy and participation of substitution vs addition – examples. Non-benzenoid aromatic compounds

Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration, halogenation, sulphonation and Friedel-Crafts reaction. Activating and deactivating substituents, orientation in mono substituted benzenes, ortho/para ratio- Orientation- Korner’s absolute method, dipole moment method – direct influence of substituents – rules of orientation - Aromatic Nucleophilic substitutions- unimolecular, bimolecular and benzyne mechanisms

UNIT – IV HETEROCYCLIC COMPOUNDS

Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Comparison of basicity of pyridine, piperidine and pyrrole.

Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution and mechanism of nucleophilic substitution reaction in pyridine derivatives.

Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

UNIT – V DYES & POLYNUCLEAR HYDROCARBONS

Dyes - theory of color and constitution - chromophore, auxochrome, classification according to application and structure - preparation and uses of azo dyes - methyl orange, triphenyl methane dyes - malachite green, indigo dyes - Indigotin, anthraquinone dyes - alizarin, phthalein dyes – Phenolphthalein-Synthesis reactions & Structure of Naphthalene & Anthracene

Reference Books

1. Textbook of Organic Chemistry - P.L.Soni - Sultan Chand
2. Advanced organic Chemistry - B.S.Bahl - S. Chand
3. Principles of Organic Chemistry - A.K.Bansal - New Age
4. A Textbook of Organic Chemistry - A.K.Bansal - New Age
5. Organic Chemistry - I.L.Finar - Volume I & II - Addison **Welsey**
6. Organic Chemistry - R.T.Morrison and Boyd - Prentice Hall
7. Stereochemistry of Organic Compounds - D.Nasipuri - New Age
8. Stereochemistry, Conformation and Mechanisms - Kalsi New Age
9. Advanced General Organic Chemistry - Sachin K.Ghosh - Books and Allied (P) Ltd
10. Textbook of Organic Chemistry - P.S.Kalsi – Macmillan
11. Organic Chemistry – Bhupinder Mehta and Manju Mehta - PHI Learning (P) Ltd.

Physical chemistry-III

UNIT I: THERMODYNAMICS-III

Van't Hoff isotherm and isochore - Clapeyron equation-Clapeyron-Clausius equation- Applications of Clapeyron-Clausius equation.

Third law of thermodynamics: Nernst heat theorem- statement of III law and its applications. Exception to third law- experimental verification of the law-residual entropy-Evaluation of absolute entropy from heat capacity measurements.

Partial molar properties: Partial molar free energy. The concept of chemical potential – variation of chemical potential with T and P- Gibbs Duhem equation- concept of fugacity and activity- activity coefficient- standard states.

UNIT – II ELECTROCHEMISTRY –II

Galvanic cells – Reversible and Irreversible cells – EMF and its measurement – Weston Standard cell – types of reversible single electrodes – standard Hydrogen electrode – calomel electrode – Derivation of Nernst equation both for emf of cells and single electrode potentials – Nernst theory for single electrode potential –standard reduction potentials – electro chemical series – significance.Application of emf measurements – Application of Gibbs –Helmholtz equation to galvanic cells – calculation of thermodynamic quantities – pH using hydrogen, quinhydrone and glass electrodes – potentiometric titrations. Concentration cells – electrode concentration cells- electrolyte concentration cells- concentration cells with and without transference – LJP expression –polarization – over voltage- decomposition voltage.

UNIT - III SURFACE CHEMISTRY

Adsorption - physisorption and chemisorptions - adsorption of gases by solids - adsorption isotherms - Freundlich adsorption isotherm - derivation of Langmuir adsorption isotherm, statement and explanation of BET isotherm - applications of adsorption - determination of surface area – adsorption indicators.

General characteristics of catalytic reactions – phase transfer catalysis - acid base catalysis - enzyme catalysis - mechanism and kinetics of enzyme catalyzed reactions - Michaelis-Menten equation.

UNIT - IV GROUP THEORY

Concept of symmetry in chemistry - symmetry operations and symmetry elements - rotational axis of symmetry and types of rotational axes - planes of symmetry and types of planes - improper rotational axis of symmetry - identity element - groups and their basic properties – Abelian and cyclic groups - classification of molecules into point groups - the symmetry operations of a molecule form a group – H_2O and NH_3 point groups - group multiplication tables.

UNIT – V SPECTROSCOPY- I

Introduction - various types of molecular spectra - electronic, vibrational and rotational energy levels - Born-Oppenheimer approximation.

Rotation spectra of diatomic molecules - determination of bond length and moment of inertia from rotational spectra - numerical problems - selection rule, effect of isotopic substitution.

UV-visible spectroscopy: theory - types of transitions in molecules - selection rules for electronic spectra - factors affecting absorption maximum and intensity – applications.

IR spectroscopy : theory - stretching and bending vibrations - factors affecting vibrational frequencies - important spectral regions for the characterization of functional groups - fingerprint region - determination of force constant - qualitative relation of force constant to bond energies - selection rules - modes of vibrations in polyatomic molecules - vibrational modes of H_2O and CO_2 – applications - numerical problems.

Reference books :

1. B.R. Puri, L.R. Sharma & M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., Jalandhar.
2. P.L. Soni, O.P. Dharmarha & U.N. Dash, Text book of Physical Chemistry, 22nd Edn., Sultan Chand & Sons, New Delhi
3. Essentials of Physical Chemistry– B.S.Bahl, Arun Bahl, G.D.Tuli, Reprint 2006, S.Chand & Company Ltd., New Delhi-110055.
4. Physical Chemistry volumes I & II- S.Pahari, 2004, New Central Book Agency, Kolkotha.
5. Physical Chemistry-G.M.Barrow, 2005, Tata McGraw Hill Publishing Company, New Delhi.
6. Physical Chemistry-G.K.Vemulapalli, 2004, Prentice Hall of India.
7. Kemp, W. Organic Spectroscopy
8. Jag Mohan Organic Spectroscopy
9. Group theory and its Chemical Applications - P.K.Bhattacharya - Himalaya publishing House.

POLYMER CHEMISTRY

Objectives:

- To know the concept of polymerization and types of polymers
- To understand the characteristics of polymers
- To acquire knowledge about the polymerization techniques and polymer processing
- To know the chemistry of individual polymers
- To have an idea about the recent advances in polymer sciences

UNIT I - INTRODUCTION TO POLYMERS

Definition - Monomer, polymer and polymerisation - classification of polymers on the basis of (i) origin - Natural, semi synthetic, synthetic,

- (ii) Physical properties and applications - Rubbers, plastic, fibres
- (iii) Thermal response - thermoplastics, thermosetting
- (iv) Structure - Homopolymers (linear, branched, cross link or network), Copolymers (Random, Alternate, Block, Graft)
- (v) Crystallinity - non-crystalline (amorphous), semi-crystalline
- (vi) Mode of formation - Addition, Condensation Polymerisation (definition and examples only)
- (vii) Methods of polymerization - Bulk, Solution, Suspension Polymerisation (definition and examples only)

Chemistry of polymerization: Chain polymerization, free radical, ionic, co-ordination, step polymerization, polyaddition and polycondensation, miscellaneous ring opening and group transfer polymerizations.

UNIT II - CHARACTERISTICS OF POLYMERS

Glass transition temperature (T_g) - definition – Factors affecting T_g – relationships between T_g and molecular weight and melting point. Importance of T_g . Molecular weight of polymers. Number average, weight average (problems), sedimentation and viscosity average molecular weights. Molecular weights and degree of polymerization - chemical reaction - hydrolysis - hydrogenation - addition - substitution – cross-linking, vulcanisation and cyclisation reactions. Polymer degradation - basic idea of thermal, photo and oxidative degradation of polymers.

UNIT III - POLYMERIZATION TECHNIQUES AND PROCESSING

Bulk, solution, suspension, emulsion, melt condensation and interfacial poly condensation polymerizations. polymer processing - calendaring - die-casting, rotational casting - compression moulding - injection moulding - blow moulding - extrusion moulding and reinforcing.

UNIT IV - CHEMISTRY OF SOME COMMERCIAL POLYMERS

Preparation, properties and uses of the following polymers. Thermoplastics, polyethylene, polypropylene, polystyrene, polyacrylonitrile, polyvinyl chloride, nylon, polyester.

Thermosetting plastics: Phenol formaldehyde resin, urea formaldehyde resin, melamine formaldehyde, epoxy resin, polycarbonate.

Elastomers: Natural rubber and synthetic rubber, Styrene and neoprene rubber.

UNIT V - ADVANCES IN POLYMER

Biopolymers - Biomedical polymers - contact lens, dental polymers, artificial heart, kidney, skin and blood cells - High temperature and fire resistant polymers - silicones - conducting polymers - (elementary idea) - polysulphur nitrile, polyphenylene, polypyrrole and polyacetylene. Polymer industry in India.

References books:

1. V.R. Gowarikar, N.V. Viswanathan and J. Sreedhar. Polymer Science, Wiley Eastern, 1995.
2. F.N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.
3. Material Science II edition, P.K. Palanisamy SCITECH Publications India Pvt., Ltd., Chennai-600001.
4. Engineering Chemistry, V Srinivasan, S.D. Uma Maheshwari, M. Meena. SCITECH Publications India Pvt., Ltd., Chennai-600001.
5. Introduction to Organic Chemistry. John McMurry Brooks/cole Cenage Learning India Private Limited. First Reprint 2008.
6. Modern Chemistry, David. W. Oxtoby, H.P. Gills, Alan Campion Brooks/cole Cenage Learning India Private Limited. First Reprint 2008.

Bioinorganic chemistry

Objectives

To study the significance of metal ions' transport and storage,

To study a few metallo enzymes,

To study electron transfer proteins,

To study oxygen transport and activation proteins,

To study the fundamentals of supramolecular chemistry

Unit I Metal ions in biology

Metal ions in biology- Essential and trace elements in biological system – biological importance and toxicity of elements such as Fe , Cu , Zn , Co , Mo , W , V , Mn , and Cr in biological system and their vital role in the active site- Ion transport mechanism in cell membrane – Na and K pumps- Ionophores.

Unit II Metallo porphyrins

Chlorophyll – photosynthetic electron transport sequence – biological electron carriers : iron-sulphur proteins-ferredoxin, rubridoxin and cytochromes , cytochromes and blue copper proteins – oxygen carriers: haemoglobin and myoglobin dioxygen binding - co-operativity in haemoglobin - the Bohr effect -, Vitamin B12 and cytochrome P450-mechanism of action

Unit III Metallo enzymes

Role of Zinc in enzyme chemistry-Zinc finger, Zinc twist and zinc cluster Structure and functions of Metallo proteins and enzymes - superoxide dismutase, carbonic anhydrase carboxypeptidase A, Catalase, LADH, and Peroxidase.

Unit IV Metals and Health

Application of therapeutic chelating agents- Metal-based drugs cis-platin, carboplatin, platinum anti-cancer drugs, gadolinium MRI contrast agents, Gold and arthritic agents – auranofin,solganol,myochristin, Toxicity of metals–Cd,Hg and Cr-bio methylation of mercury

Unit V Supramolecular chemistry

Concepts of supramolecular chemistry. – Host-Guest concept- Various types of non-covalent interactions. Hydrogen bonds, C-H...X interactions, Halogen bonds. $\pi - \pi$ interactions, non – bonded interactions. Various types of molecular recognition- Cations, Anions and Neutral guests – Supramolecular Devices and Sensors: Various types of supramolecular devices – an overview

Reference Books:

1. Lippard, S.J. & Berg, J.M., Principles of Bioinorganic Chemistry Panima Publishing Company 1994. Cotton, F.A., Wilkinson, G., & Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India,
2. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4 th Ed., Harper Collins 1993, Pearson, 2006.
3. Sharpe, A.G. Inorganic Chemistry, 4 th Indian Reprint (Pearson Education) 2005
4. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry 3rd Ed., John Wiley and Sons, NY, 1994.
5. Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements 2 nd Ed, Elsevier, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
6. JW Steed and JL Atwood Supramolecular Chemistry 2nd Ed. Wiley 2011
P D Beer, P A Gale and D K Smith Supramolecular Chemistry OUP, 1999
J-M Lehn Supramolecular Chemistry VCH, 1995
7. Lee, J.D. Concise Inorganic Chemistry 5 th Ed., John Wiley and sons 2008.
8. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
9. Shriver, D.D., Atkins, P. and Langford, C.H., Inorganic Chemistry 2 nd Ed., Oxford University Press, 1994.
10. David E Fenton, Bio coordination chemistry, oxford science publications. 1995
11. Asim K. Das, Bioinorganic Chemistry, Books and allied (P) Ltd. 2007.

ANALYTICAL CHEMISTRY

Objective :

To know the importance of analytical chemistry and to study about the different types of analytical techniques

UNIT I - ERRORS AND DATA ANALYSIS

Definition and explanation with examples of the terms – mean, median, mode, range, deviation, mean deviation, relative mean deviation, standard deviation, coefficient of variation and variance – accuracy and precision – types of errors – random and systematic errors – methods of detection and elimination of systematic errors – student's t-test – confidence levels – Q-test for rejection of result – curve fitting – method of least squares – significant figures and computational rules.

UNIT II - WATER ANALYSIS

Sampling and preservation of water samples – physical examination of water : color, odour, turbidity, taste and electrical conductivity – chemical characterisation : pH, acidity, alkalinity, TDS, total, temporary, permanent, calcium and magnesium hardness, chloride, fluoride, BOD, COD, detergents and pesticides – residual chlorine and chlorine demand – Bacteriological examination : total and faecal coliforms.

UNIT III - FUEL ANALYSIS

Solid fuels : coal – classification – proximate analysis : moisture content, ash content, volatile matter and fixed carbon – ultimate analysis : carbon, hydrogen, nitrogen, sulphur and oxygen – heating values – grading of coal – comparison of coal and coke – liquid fuels : flash point, aniline point, octane number and carbon residues – gaseous fuels : producer gas and water gas – calorific values.

UNIT IV - ELECTROANALYTICAL TECHNIQUES

Electrogravimetry : principle, instrumentation and applications. Coulometry : constant current coulometry – coulometric titrations – applications – potentiostatic coulometry – Polarography : principle – experimental assembly – working – advantages and disadvantages of DME – applications to qualitative and quantitative analysis. Amperometric titrations : theory – apparatus – general procedures – applications – advantages.

UNIT V - SPECTROANALYTICAL AND THERMOANALYTICAL METHODS

Spectroanalytical methods : principle, instrumentation and applications of colorimetry, spectrophotometry and fluorimetry – light scattering techniques: nephelometry and turbidimetry.

Thermo analytical methods : principle, instrumentation and applications of TGA and DTA – characteristic features of TGA and DTA curves – factors affecting TGA and DTA curves – simultaneous DTA - TGA curves – thermometric titrations.

Reference books:

- 1) D.A.Skoog, D.M.West and Holler, *Analytical Chemistry : An introduction*, 6th Ed., Saunders College Publishing.
- 2) Gary D. Christian, *Analytical Chemistry*, 6th Ed., John Wiley & Sons.
- 3) S.M.Khopkar, *Environmental Pollution Analysis*, 1st Ed., Wiley Eastern Ltd.,
- 4) APHA, *Standard Methods for Estimation of Water and Waste water*, 19th Ed., American Public Health Association.
- 5) O.P.Vermani and A.K. Narula, *Applied Chemistry*, 2nd Ed., New Age International Publishers.
- 6) A.K.Shaha, *Combustion Engineering and Fuel Technology*, Oxford & IBH Publishing Company.
- 7) D.A.Skoog, Holler and Nieman, *Principles of Instrumental Analysis*, 5th Ed., Saunders College publishing.
- 8) Hobart H.Willard, Lynne L.Merritt, John A.Dean and Frank A. Settle, *Instrumental Methods of Analysis*, 7th Ed., CBS Publishers & Distributors Pvt. Ltd.,

PHARMACEUTICAL CHEMISTRY

Objectives

- i. To understand the concepts and terminologies of pharmaceutical chemistry
- ii. To know the mechanism of action and metabolism of drugs
- iii. To study the functions of various drugs
- iv. To know the important diseases and their treatment
- v. To study the common diseases and important disorders of human beings and the drugs used in the treatment.

UNIT-I IMPORTANT TERMINOLOGIES, CLASSIFICATION AND ASSAY

Important terminologies - pharmacology, molecular pharmacology, pharmacophore , metabolites, antimetabolites, virus, bacteria, fungi, actinomycetes, mutation, pharmacognosy, pharmacotherapeutics, toxicology, chemotherapy – classification of drugs – nomenclature of drugs – nonproprietary names – sources of drugs – assay of drugs (biological, chemical, immunological)

UNIT-II MECHANISMS, METABOLISMS AND MEDICINAL PLANTS

Mechanism of drug action – absorption, drug delivery, drug excretion –Metabolism of drugs –chemical pathways of drug metabolism – phase – I (oxidative, reductive and hydrolytic reactions) and phase - II (conjugate reactions). Physiological effects of different functional groups in drugs –biological role of Na, K, Ca, Cu, Zn and iodine.

Indian medicinal plants – Tulsi, neem, Keezhanelli, adathode, thoothuvalai

UNIT- III DRUGS AND FUNCTIONS

Analgesics- narcotic analgesics- analgesic action, uses and structure activity of morphine. Non-narcotic analgesics –aspirin and paracetamol. Anaesthetics- local anaesthetics – procaine- General anaesthetics- chloroform and halothane. Antibiotics – Therapeutical values of penicillin, tetracyclines, chloramphenicol and streptomycin. Sulpha drugs – sulphanilide, sulphadiazine and cotrimoxazole. Antiseptics and disinfectants – phenols, chloramines and organicmercurials. Antidepressants – barbiturates – mechanism of action and uses. Antipsychotic drugs – piperazine and benzamides.

UNIT-IV DISEASES AND TREATMENT

Composition of blood – blood grouping and matching – Rh factor. Blood pressure – causes, control and treatment- antihypertension drugs- antianginal agents cardiovascular drugs, cardiacglycosides, vasodilators (one example for each). Anaemia – causes and control – antianemic drugs. Diabetes – causes and control – hypoglycemic drugs – insulin – oral hypoglycemic drugs (tolubutamide and chlorpropamide). Cancer- causes and treatment – cobalt therapy - antineoplastic drugs (chlorambucil, methotrexate, plant products and hormones).

UNIT- V COMMON DISEASES AND HEALTH CARE MEDICINES

Common diseases – causes and treatment of insect borne diseases (Malaria and Filariasis), Airborne diseases (Diphtheria, Whooping cough, Influenza, common cold, TB) and Water borne diseases (Cholera, Typhoid and Dysentery). Digestive disorder – Jaundice. Respiratory disorder – Asthma . Nervous system disorder – epilepsy. Other diseases – Leprosy.

Health care medicines – Sources and deficiency diseases of Vitamins A, B complex, C , D, E and K.

Reference books:

1. A text book of pharmaceutical chemistry, Jayashree ghosh, S. Chand, 2003.
2. Pharmaceutical Chemistry by S. Lakshmi, Sultan Chand & Sons, 3rd edition (2004).
3. Medicinal Chemistry, Ashutosh kar, New Age International, 1992
4. Pharmaceutical chemistry – G.R. Chatwal
5. Pharmacology and Pharmatherapeutics – R.S. Satoskar and S.D. Bhandarkar.
6. Drugs , G.L.D. Krupadanam, D.V. Prasad, K.V.Rao, K.L.N.Reddy and C.Sudhakar,Tata McGraw- Hill Publishing Company,New Delhi.
7. Medicinal chemistry, G.R.Chatwal, Himalaya Publishing House, New Delhi (2002)

INORGANIC CHEMISTRY – III

Objectives

To study the theories in coordination chemistry

To study the chemistry of metal carbonyls

To understand the role of metal ions in biological systems

To study the basic principles of photoinorganic chemistry

UNIT - I COORDINATION CHEMISTRY-I

Introduction: IUPAC nomenclature, Ligands- monodentate, bidentate, and polydentate ligands; coordination sphere; coordination number; nomenclature of mononuclear and dinuclear complexes. Structural and stereoisomerism in tetrahedral, square planar and octahedral complexes. Valence Bond theory – applications of valence bond theory to tetrahedral, square planar and octahedral complexes- Merits and limitations of VB theory.

UNIT – II CO-ORDINATION CHEMISTRY II

Crystal field theory - splitting of d-orbitals in octahedral and tetrahedral complexes - factors affecting the magnitude of crystal field splitting - effects of crystal field splitting - spectrochemical series - applications of CFT - magnetic properties and spectra of transition metal complexes - crystal field stabilization energy and their uses - limitations of CFT - effective atomic number rule - stability of complexes - step-wise and overall stability constants - factors affecting the stability of complexes - determination of stability constants.

UNIT – III CO-ORDINATION CHEMISTRY III

Labile and inert complexes - ligand substitution reactions in octahedral complexes: aquation, base hydrolysis and anation reactions - substitution reactions in square planar complexes - Trans effect - theories of trans effect - mechanism of substitution reactions - redox reactions: inner-sphere and outer-sphere electron transfer reactions.

UNIT - IV ORGANOMETALLIC CHEMISTRY

Introduction–History, Nomenclature of organometallic compounds, EAN rule and 18 electron rule. Structure and nature of M-L bond in metal carbonyls - metal nitrosyls. preparation of organo metallic compounds of Mg, Zn, Li, Cu, P, B, Ti, Fe and Co

Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler – Natta catalyst and polymerization of olefins.

UNIT - V Inorganic photochemistry

Electronic transitions in metal complexes : selection rules - metal-centered and charge-transfer transitions - properties of excited states - bimolecular quenching and energy transfer - photochemical pathways : substitutional, reduction-oxidation and isomerisation processes - photosubstitution reactions of Cr(III) complexes - Adamson's rules - photoredox reactions of Co(III) complexes - photoisomerisation in Pt(II) complexes. Photochemical conversion and storage of solar energy : photolytic cleavage of water into H₂ and O₂ - photoelectrochemical devices : photogalvanic cells and semiconductor based photovoltaic cells.

Reference books :

1. J.D. Lee, *Concise Inorganic Chemistry* 5th Ed., Blackwell Science Ltd.,
2. James E. Huheey, Elien A. Keiter and Richard L. Keiter, *Inorganic Chemistry : Principles Structure and Reactivity*, 4th Ed., Harper College Publisher.
3. F. Albert Cotton, Geoffrey Wilkinson, Carlos A. Marilo and Manfred Bochman, *Advanced Inorganic Chemistry*, 6th Ed., Wiley Interscience Publication.
4. Fred Basolo and Ralph G. Pearson, *Mechanisms of Inorganic Reactions : A study of metal complexes in solution*, 2nd Ed., John wiley and sons, Inc.,
5. David E. Fenton, *Biocoordination Chemistry*, 1st Ed., Oxford Science Publications.
6. Ivano Bertini, Harry B Gray, Stephen J Lippard, Joan Selverstone Valentine, *Bioinorganic Chemistry*, 1st Ed., Viva Books Pvt. Ltd.,
7. J.K. Rohatgi - Mukherjee, *Fundamentals of Photochemistry* - Wiley Eastern Revised Ed.,
8. *Journal of Chemical Education*, Vol.60, No.10, October 1983.
9. A.W. Adamson and P.D. Fleischauer, (Editors) *Concepts of Inorganic photochemistry*, John wiley and sons, New York, 1975.

ORGANIC CHEMISTRY-IV

UNIT-I CARBOHYDRATES

Classification-Monosaccharides- constitution of glucose and fructose. Reactions of glucose and fructose – Osazone formation, Mutarotation and its mechanism, cyclic structure, pyranose and furanose forms. Epimerisation-Chain lengthening and shortening of aldoses. Interconversions of aldoses and ketoses.

Disaccharides- sucrose- reactions and structure.

Polysaccharides – starch and cellulose (elucidation of structure not necessary).

UNIT-II PHENOLS, AROMATIC ALDEHYDES, KETONES AND ACIDS

Phenols

Acidic character of phenols- effect of substituents on acidity of phenols - Mechanisms of Kolbe's reaction and Reimer-Tiemen reaction. Preparation of cresols, catechol, resorcinol, quinol and euginol.

Aldehydes and ketones

Preparation and uses of cinnamaldehyde. Coumarin, vanillin, Michler's ketone, p-benzoquinone-Quinone mono oxime tautomerism. Mechanism of Cannizzaro reaction, benzoin condensation, Perkin reaction, Claisen reaction, Knoevenagel reaction, Gattermann aldehyde synthesis and Houben –Hoesch synthesis.

Aromatic acids

Ortho effect, preparation of mandelic acid, cinnamic acid and anthranilic acid. Preparation and uses of benzene-1,2- dicarboxylic acid, benzene-1,3- dicarboxylic acid and 1,4- dicarboxylic acid.

UNIT III REARRANGEMENTS

Rearrangement to electron-deficient carbon – 1,2 shift (Wagner-Meerwein rearrangement, pinacol rearrangement, Wolff rearrangement in Arndt-Eistert synthesis, benzil-benzilic acid rearrangement).

Aromatic rearrangements from oxygen to ring carbon (Fries rearrangement, Claisen rearrangement and benzidine rearrangement).

Rearrangement to electron-deficient nitrogen (Beckmann rearrangement, Schmidt rearrangement, Hofmann rearrangement, Curtius rearrangement).

Rearrangement to electron-deficient oxygen (Baeyer-Villiger oxidation, hydroperoxide rearrangement, cumene hydroperoxide-phenol rearrangement), Dakin reaction.

UNIT IV TERPENOIDS AND ALKALOIDS

Terpenes and terpenoids - classification - isoprene rule.

Elucidation of structure and synthesis of citral, limonene, menthol, α -terpineol and camphor.

Alkaloids: Introduction, classification and general methods for the determination of structure.

Structural elucidation and synthesis of conine, piperine and nicotine

UNIT-V ORGANIC SPECTROSCOPY

UV spectroscopy - chromophore – auxochrome – blue shift, red shift – hypochromic shift, hyperchromic shift – applications for studying functional groups, cis-trans isomerism and nature of double bonds- Woodward-Fischer rules as applied to conjugated enes and alpha and beta unsaturated ketones.

IR spectroscopy – characteristics of IR absorption frequencies – intermolecular and intramolecular hydrogen bonding – functional group detection.

NMR Spectroscopy - interpretation of NMR spectra of simple organic compounds such as acetone, anisole, benzaldehyde, isobutene, mesitylene, 1-chloropropane, ethyl methyl ketone, benzyl alcohol, and propionic acid.

Reference Books

1. K.S. Tewari, N.K. Vishil, S.N. Mehotra – A text book of org. chem – 1st edition, Vikas Publishing House Pvt Ltd., 2001, New Delhi.
2. P.L. Soni, Text Book of Organic chemistry, Sultans Chand, 1991, New Delhi,
3. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
4. Gurdeep Chatwal, Reaction mechanisms and reagents in organic chemistry
5. O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
6. Gurdeep Chatwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002
7. Y.R. Sharma, O.P. Vig, Elementary organic absorption spectroscopy – 1st edition, Goel Pulishers, 1997, Meerut
8. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI Limited, New Delhi, 1992.
9. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley and Sons, New York, 1992.
10. S. H. Pine, Organic Chemistry, 5th Edition, McGraw Hill International Edition, Chemistry Series, New York, 1987.

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Physical chemistry – IV

UNIT - I SPECTROSCOPY -II

Raman spectroscopy: Principle - Rayleigh and Raman scattering - Stokes and Anti-stokes lines - differences between IR and Raman spectroscopy - mutual exclusion principle – selection rule - applications.

NMR spectroscopy: Theory of NMR, modes of nuclear spin-relaxation process - shielding effect, hyperfine splitting, coupling constants, - chemical shift - factors affecting chemical shift - internal standard, δ and τ scale - applications of NMR and limitations of NMR.

ESR spectroscopy: principle - energy level splitting - presentation of ESR spectrum for methyl and benzene radicals, deuterium - applications

Mass spectroscopy: basic principles of mass spectrum - molecular peak - base peak - isotopic peak - meta stable peak - types of fragmentation - factors influencing the fragmentation - Mc-Lefferty rearrangement - applications

UNIT – II CHEMICAL KINETICS

Rate of reaction-Measuring rates of reaction-expressing reaction rates- factors influencing rate- rate constant-Rate laws, Stoichiometry, order and molecularity of reactions- First order, second order, third order and zero order reactions and example. Characteristics of I,II,III and Zero order reactions. Determination of order of reactions-expression for rate constant of first and second order reaction-derivation. Effect of temperature on rate constant. The activation energy - determination of Arrhenius frequency factor and energy of activation-The collision theory of reaction rates and its limitation. Lindemann theory of unimolecular reactions-The theory of Absolute reaction rates. Comparison of the collision theory with the Absolute reaction rate theory.

UNIT – III IONIC EQUILIBRIA

The Ostwald's dilution law-experimental verification-limitations-acids and bases-Lewis concept-dissociation of weak acids and weak bases-dissociation of water-pH scale-common ion effect- its applications-buffer solution-different types-calculation of pH value of buffer solution. Hydrolysis of salts - salts of weak acids & strong base, salts of weak base and strong acids, salts of weak acid and weak base - determination of degree of hydrolysis. Acid-base indicators- acid-base titration and use of indicators. Solubility product - Application of solubility product principle

UNIT-IV PHASE EQUILIBRIA

Phase rule - phase, component, degree of freedom - thermodynamic derivation of phase rule,

One-component system: Phase diagrams of Water and sulphur systems.

Two component system: (i) Simple eutectic: Lead-silver system and potassium iodide-water system. (ii) Formation of compound with congruent melting point: Magnesium – zinc system and ferric chloride – water system. Distribution Law-Statement and thermodynamic derivation- association of the solute in one of the solvents- dissociation of the solute in one of the solvents- applications of the distribution law-solvent extraction.

UNIT - V NANOCHEMISTRY

Definition - size dependent properties: magnetic, electrical and optical properties – quantum dots – metal oxides and metal nano particles - ceramic nano particles

Synthesis of nanomaterials - bottom-up and top-down approaches - thin film deposition - catalytic assisted growth - chemical vapour deposition - sol gel method - chemical reduction

Fullerenes - carbon nanotubes - single walled and multi walled nano tubes – structures - carbon nanofibre – nanocomposites.

Applications of nanoscience and nanotechnology.

Reference books :

1. Principles of Physical Chemistry - B.R. Puri and Sharma - Shobanlal Nagin Chand & Co.,
2. Text Book of Physical Chemistry - P.L. Soni - Sultan Chand.
3. Elements of physical chemistry - Glasstone and Lewis - Macmillan.
4. Physical chemistry - G.W. Castellan - Narosa publishing house.
5. Universal General Chemistry, C.N.R. Rao, Macmillan.
6. Nano: The Essentials Understanding Nano Science and Nanotechnology. T. Pradeep -. Tata Mc Graw-Hill Publishing Company Ltd. New Dehli.
7. Introduction to Nano technology, Charles P Poole Jr. & Frank J Owens, Wiley Interscience
8. Kemp, W. Organic Spectroscopy
9. Jag Mohan Organic Spectroscopy
10. Chemical Kinetics-K. J. Laidler, Tata McGraw Hill Publishing Company, NewDelhi

Elective –III (A)

GREEN CHEMISTRY

Objectives

To introduce the basics and need for Green Chemistry

To understand the principles and designing a green synthesis of selected compounds

To make the students familiar with the usage of green solvents and green catalysts in chemical reactions.

To learn the principles of the microwave and ultrasound assisted reactions.

UNIT- I Introduction to green chemistry

Definition – need for green chemistry – scope of green chemistry.

Concept of atom economy – yield – mass intensity and atom economy.

Calculation of atom economy, mass intensity, mass productivity and carbon efficiency.

Different types of reactions and atom economy - addition, substitution, elimination and rearrangements.

Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diastereoselectivity.

UNIT- II Green solvent

Super critical fluids – Introduction – extraction of super critical fluids – solvents of super critical fluid– advantages and applications.

Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide - advantages and applications.

Chemical reactions in supercritical water and Near – Critical Water (NCW)- Region.

Extracting natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation

Ionic liquid as green solvent : Introduction – synthesis of ionic liquids - acidic ionic liquid and neutral ionic liquids – applications in organic synthesis.

Green reagents : Dimethyl carbonate and Polymer supported reagents.

UNIT- III Green catalyst

Catalysis over view : acid catalyst - basic catalyst – oxidation catalyst – polymer supported catalyst- photosensitized super acid catalyst and Tetra Amido Macrocylic Ligand (TAML) catalyst.

Biocatalyst : microbial oxidation, microbial reduction, enzyme catalyzed hydrolytic process, per fluorinated catalyst and modified biocatalyst.

Development of mesoporous supports by liquid crystal templating – neutral templating methods- heterogeneous catalyst – solid supported catalyst.

UNIT- IV Green synthesis

Green synthesis of the following compounds -Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibruprofen and Paracetamol

Microwave assisted reactions in water – Hoffmann Elimination, Hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols

Microwave assisted reactions in organic solvents – Esterification, Fries rearrangement, Claisen Rearrangement, Diels-Alder Reaction and Decarboxylation. Ultra sound assisted reactions – Esterification, Saponification, alkylation , oxidation, reduction, coupling reactions and Cannizaro reactions.

UNIT -V Green reactions involving basic principle of green chemistry.

Twelve principle of green chemistry – choice of starting materials – biomimetic, multifunctional reagents – materials reagents.

Combinatorial green chemistry – green chemistry in sustainable developments.

Importance of Green chemistry in day to day life, versatile bleaching agents and analgeric drugs.

References

1. V.K.Ahluwallia &M.R Kidwai “New Trends in Green Chemistry”, Anamalaya Publishers (2005)
2. P.T.Anaster &J.K.Warnerr “ Oxford Green Chemistry,Theory and Practical”,University Press(1998)
3. A.S. Matlack,” Introduction to Green Chemistry”-Marcel Deckkar (2001)
4. V.K.Ahluwallia, “Green Chemistry Environmentally Benign Reaction”Ane Books Pvt.Ltd. New Delhi (2009)
5. Rashmi Sanngi &MM Srivastava, “Green Chemistry Environment Friendly Alternatives.” Narosa Publishing House Pvt Ltd, New Delhi (2009)

Elective –III (B)

NANO CHEMISTRY

Objectives

To give an insight into the basics of nanochemistry.

To understand the difference between bulk material and nanomaterial and learn the synthesis, application and fabrication of nanostructure.

To study the importance of nanocatalyst, nanocomposites and fibers.

To make the students familiar with the characterization and applications of nanomaterials.

UNIT- I Introduction to Nano chemistry.

Definition: nanoscience – nanotechnology – nanochemistry – significance of nanoscale - factors responsible for special properties of nanomaterials.

Nanomaterials: Different types of nanomaterials and structures- quantum wells – quantum wires – quantum dots – nanoclusters – nanocrystals – nanowires and nanotubes.

Feynman’s Prophecy– manufacturing of nanomaterials - top-down and bottom-up approaches.

UNIT-II Synthesis of nano particles.

Introduction – orientation of nanoparticles – synthesis of nanoparticles.

Physical methods: laser ablation, physical vapour deposition (PVD) and solvated metal atom dispersion (SMAD).

Chemical methods: thermolysis, sonochemical method, reduction methods, phase-transfer processes and biosynthesis of nanoparticles.

Synthesis of nanosized semiconductors: precipitation methods and thermal decomposition of complex precursors.

Synthesis of ceramics: physical methods, gas condensation method, laser method, chemical methods and sol-gel synthesis.

UNIT –III Nanocatalyst and carbon based nanomaterials

Introduction – fundamentals of catalysis – adsorption of a molecule on a catalyst surface, adsorption theory- Langmuir adsorption isotherm.

Surface reactions – synthesis – synthesis requirements, example of a conventional synthetic technique, non traditional methods for preparing nanocatalyst.

Characterization of nanocatalyst : overview - bulk characterization technique and surface characterization technique

Carbon nanomaterials : structure and properties of graphite, diamond and fullerenes.

UNIT-IV Nanocomposites and fibers.

Introduction - Background - types of composite materials - The nano perspective.

Physical and chemical properties of materials – mechanical properties, thermal properties, electronic properties and chemical properties.

Natural nanocomposites - Skin of the sea cucumber and hard natural nanocomposites.

Carbon fibers and nanotubes – Types of fibers, Whiskers and nanotubes – synthesis of fibers and nanotubes - chemical modification and applications of carbon nanotube.

Metal and Ceramic nanocomposites - Metal nanocomposites, inorganic nanofibers and concrete.

Clay nanocomposite materials -polypropylene clay nanocomposite , montmorillonite clay nanocomposite and halloysite nanotube claycomposites.

UNIT-V Characterization and applications of nanomaterials.

Types of characterization methods – Electron probe method- Scanning electron microscopy – Transmission electron microscopy,

Spectroscopic Methods, - UV – Visible adsorption and emission spectroscopy, Infra Red and Raman spectroscopy and X-ray diffraction methods.

Current applications: sunscreens and cosmetics – nano medicine, drug delivery and cancer drugs – food and drinks, textiles, chemical industry and electronic devices.

Short term applications - paints – fuel cells – displays – batteries – fuel additives and catalysts.

Long term applications- composites – lubricants – magnetic materials – medical implants – machinable ceramics – water purification and military battle suits.

References

1. Geoffrey A. Ozin and Andre C. Arsenault, “Nanochemistry: A chemical approach to nanomaterials”, RSC publishing, (2005), U.K.
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, New York,(2002).
3. C.N.R. Rao, A. Muller and A.K. Cheetham, “The Chemistry of Nanomaterials, Volume I & II”, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, (2004).
4. Kenneth J. Klabunde, “Nanoscale Materials in Chemistry”, Wiley-Interscience”, New York,(2001).
5. Gabor L.Hornyak, Harry F. Tibbals, Joydeep Dutta and John J Moore . “Introduction to Nanoscience and Nanotechnology” CRC Press ,Taylor and Francis group London Newyork.

(V & VI SEMESTERS)

GRAVIMETRIC ESTIMATION & INORGANIC PREPARATIONS

Objectives

- ❖ To enable the students to understand the various techniques in gravimetric estimations
- ❖ To make the students thorough in inorganic complex preparations

Gravimetric Estimation

1. Estimation of lead as lead chromate
2. Estimation of barium as barium chromate
3. Estimation of nickel as nickel dimethylglyoximate
4. Estimation of zinc as zinc oxinate
5. Estimation of copper as copper thiocyanate

Inorganic preparations

1. Preparation of potash alum
2. Preparation of chrome alum
3. Preparation of Prussian blue
4. Preparation of sodium ferrioxalate
5. Preparation of tetrammine copper(II) sulphate
6. Preparation of trithiourea copper(I)chloridedihydrate
7. Preparation of potassium trisoxalatoferrate(III)
8. Preparation of hexathiourea lead(II) nitrate

Internal – 25 marks

05 marks - Regularity

20 marks – Average of best (estimation-3 and preparation-5) eight experiments in regular class work

External -75 marks

15 marks – Record (atleast eight experiments estimation-3 and preparation-5)*

10 marks – Procedure (estimation-5 and preparation-5)

50 marks – Result (estimation-30 and preparation-20)

*Experiments done in the class alone should be recorded

(Students having a bonafide record only should be permitted to appear for the practical examination)

Reference books:

1. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part III), S. Viswanathan Co. Pvt., 1996.
2. Vogel's Text Book of Quantitative Chemical Analysis. 5th Edi., ELBS/Longman England, 1989.
3. O.P. Pandey, D.N Bajpai, S. Gini, Practical Chemistry, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.
4. V.K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate College Practical Chemistry, Universities Press (India) Pvt Ltd 2008 (reprint)

(V & VI SEMESTERS)

ORGANIC ANALYSIS & ORGANIC PREPARATION

Objectives

- ❖ To enable the students to understand the various procedures in organic analysis and organic preparation
- ❖ To create an awareness on microscale experiments in organic chemistry practicals

1. Organic analysis

Qualitative analysis of the given organic compound

- a. Test for aliphatic and aromatic nature of substances
- b. Test for saturation and unsaturation
- c. Identification of functional groups (carboxylic acids, phenols, aldehydes, ketones, esters, amines, amides, anilides, nitrocompounds and carbohydrates)
- d. Preparation of solid derivative to confirm the presence of functional group

2. Organic preparation

1. Preparation of salicylic acid from methyl salicylate (or) benzoic acid from ethylbenzoate
2. Preparation of benzoic acid from benzamide
3. Preparation of benzoquinone oxime from benzoquinone
4. Preparation of benzoic acid from benzaldehyde
5. Preparation of p-bromoacetanilide from acetanilide
6. Preparation of 2-naphthyl benzoate from 2-naphthol
7. Preparation of picric acid from phenol
8. Preparation of methyl orange from sulphanilic acid
9. Preparation of glucosazone from glucose

Internal – 25 marks

05 marks - Regularity

20 marks – Average of best (estimation-3 and preparation-5) eight experiments in regular class work

External -75 marks

15 marks – Record (atleast eight experiments in organic analysis and five preparations)*

10 marks – Procedure

50 marks – Result (analysis-30 and preparation-20)

*Experiments done in the class alone should be recorded

(Students having a bonafide record only should be permitted to appear for the practical examination)

Reference books:

1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt., 1998.
2. J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry. 5th Edn., Pearson Education, 2005.
4. O.P. Pandey, D.N Bajpai, S. Gini, Practical Chemistry, for I, II & III BSc. Students. S.Chand & Company Ltd reprint 2009.
5. P.R.Singh, D.C.Gupta, K.S.Bajpal Experimental Organic Chemistry Vol.I and II, 1980.

(V & VI SEMESTERS)

PHYSICAL CHEMISTRY EXPERIMENTS

Objectives

- ❖ To enable the students to understand the principles of physical chemistry experiments
1. Determination of molar mass of the given substance by Rast macro method
 2. Determination of molecular weight of the given substance by Transition temperature method
 3. Determination of solubility of a substance at different temperatures and calculation of heat of solution
 4. Study of adsorption of oxalic acid on charcoal and verification of Freundlich isotherm
 5. Study of phase equilibrium – Simple eutectic
 6. Estimation of HCl by conductometric method using standard oxalic acid (to be prepared) and link NaOH
 7. Estimation of MgSO_4 by conductometric method using standard MgSO_4 (to be prepared) and link BaCl_2
 8. Estimation of Fe(II) by potentiometric method using standard ferrous ammonium sulphate (to be prepared) and link KMnO_4
 9. Estimation of KMnO_4 by potentiometric method using standard $\text{K}_2\text{Cr}_2\text{O}_7$ (to be prepared) and link ferrous ammonium sulphate
 10. Determination of equivalent conductance of weak electrolyte and calculation of dissociation constant
 11. Comparison of the strengths of acids by studying the kinetics of ester hydrolysis
 12. Determination of CST of phenol-water system. Study of the effect of impurity on CST and determination of the strength of unknown

Internal – 25 marks

05 marks - Regularity

20 marks – Average of best eight experiments in regular class work

External -75 marks

15 marks – Record (atleast eight experiments)*

10 marks – Procedure

50 marks – Exprimment

*Experiments done in the class alone should be recorded

(Students having a bonafide record only should be permitted to appear for the practical examination)

Reference books:

1. J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.
3. David P. Shoemaker, Carl W. Garland, Joseph W. Nibler, Experiments in Physical Chemistry, 5th Edi., McGraw- Hill Book company, 1989.
4. Alexander Findlay and J.A. Kitcher. Practical Physical Chemistry, Longmans
5. Y.B. Yadav, Practical Physical Chemistry, Goel publishing house