



ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Chemistry (w.e.f:2023-24A.B)

IV - SEMESTER

COURSE CODE 9: PHYSICAL CHEMISTRY -II

(States of Matter, Phase Rule & Surface Chemistry)

Credits: 03

I. Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Explain the difference between solids liquids and gases in terms of intermolecular interactions.
2. Differentiate ideal and real gases.
3. Discuss the basic concepts of two component systems
4. Apply the concepts of adsorption.
5. Understand the basic concepts of crystallography.

II. Syllabus:

Unit I - Gaseous state (9 h)

Postulates of Kinetic theory of Gases (exclude derivation) – deduction of gas laws from kinetic gas equation-Vander Waal's equation of state. Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. Relationship between critical constants and vander Waal's constants. Law of corresponding states. Joule- Thomson effect. Inversion temperature.

Unit II – Liquid State (9 h)

Physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Liquid crystals, mesomorphic state. Differences between liquid crystal and solid/liquid. Classification of liquid crystals into Smectic and Nematic. Application of liquid crystals as LCD devices



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UNIT-III - Solid state (9h)

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. Miller indices, Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law and its derivation. Powder method. Defects in crystals. Stoichiometric and non-stoichiometric defects.

Unit IV - Phase Rule (9 h)

The Concept of phase, components, degrees of freedom. Gibbs phase rule. Phase diagram of one component system – water system, Study of Phase diagrams of Simple eutectic systems

i) Pb-Ag system, desilverisation of lead ii) NaCl-Water system, Congruent and incongruent melting point- Definition and examples for systems having congruent and incongruent melting point, freezing mixtures

Unit V Surface Chemistry (9 h)

Definition and classification of Colloids- Coagulation of colloids- Hardy-Schulze rule. Stability of colloids, Protection of Colloids, Gold number.

Adsorption - Physical and chemical adsorption, Freundlich and Langmuir adsorption isotherm, applications of adsorption.

III. List of Reference Books:

- 1) Solid State Chemistry and its applications by Anthony R. West
- 2) Text book of physical chemistry by K L Kapoor Vol.1
- 3) Text book of physical chemistry by S Glasstone
- 4) Advanced physical chemistry by Bahl and Tuli.



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Single Major B.Sc Chemistry (w.e.f:2023-24A.B)

IV - SEMESTER

Course Code 9: Organic Preparations

Credits: 01

Course outcomes:

At the end of the course, the student will be able to:

- 1) Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
- 2) Apply concepts of surface chemistry in experiments.
- 3) Be familiar with the concepts & practical applications of Surface tension and viscosity of liquids.

Physical Chemistry Practical Syllabus:

1. Determination of surface tension of liquid by drop count method
2. Determination of surface tension of liquid by drop weight method
3. Determination of surface tension of mixture (liquid + detergent) using stalagmometer.
4. Determination of coefficient of viscosity of an organic liquid.
5. Determination of composition of a glycerol in glycerol + water mixture using viscometer.
6. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

Co-curricular activities and Assessment Methods:

- 1) Continuous Evaluation: Monitoring the progress of student's learning
- 2) Class Tests, Worksheets and Quizzes
- 3) Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality
- 4) SEMESTER -End Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the SEMESTER .



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List of reference books:

- 1) A Text Book of Quantitative Inorganic Analysis(3rd Edition) –A.I.Vogel
- 2) Web related references suggested by teacher.



IV - SEMESTER

Course Code 10: GENERAL AND PHYSICAL CHEMISTRY

Credits: 03

I. Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Correlate and describe the stereochemical properties of organic compounds.
2. Explain the biological significance of various elements present in the human body.
3. Apply the concepts of ionic equilibrium for the qualitative and quantitative analysis.
4. Determine the order of a chemical reaction.
5. Describe the basic concepts of enzyme catalysis.

II. Syllabus:

UNIT-I Stereo chemistry of carbon compounds (9 h)

Molecular representations - Wedge, Fischer, Newman and Saw-Horse formulae.

Optical isomerism: Optical activity- wave nature of light, plane polarised light, optical rotation and specific rotation. Chiral molecules- definition and criteria (Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with examples- Glyceraldehyde, Lactic acid, Alanine, Tartaric acid, 2,3-dibromopentane.

Unit II Bioinorganic Chemistry (9 h)

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals, Na / K- pump, carbonic anhydrase and carboxy peptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cisplatin as an anti-cancer drug. Iron and its application in bio-systems, Haemoglobin-transfer of oxygen, Myoglobin-Storage and transfer of iron



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Unit III Ionic equilibrium (9 h)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, Buffer solutions-Henderson's equation. Indicators-theories of acid – base Indicators, selection of Indicators,

Common ion effect Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Unit IV Chemical Kinetics-I: (9 h)

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions (similar and different reactants). Half-life of a reaction. General methods for determination of order of a reaction.

Unit V Chemical Kinetics-II: (9 h 0

Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Enzyme catalysis- Specificity, factors affecting enzyme catalysis, Inhibitors and Lock & key model. Michaels- Menten equation- derivation, significance of Michaelis-Menten constant.

III. Reference books

- 1) Text book of physical chemistry by S Glasstone
- 2) Concise Inorganic Chemistry by J.D.Lee
- 3) Advanced physical chemistry by Gurudeep Raj
- 4) Advanced physical chemistry by Bahl and Tuli
- 5) Inorganic Chemistry by J.E.Huheey
- 6) Basic Inorganic Chemistry by Cotton and Wilkinson.



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Single Major B.Sc Chemistry (w.e.f:2023-24A.B)

IV - SEMESTER

Course Code 10: Physical Chemistry - Volumetric Analysis

Credits: 01

Physical Chemistry - Volumetric Analysis

IV. Course outcomes:

At the end of the course, the student will be able to;

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Understand and explain the volumetric analysis based on fundamental concepts learnt in ionic equilibria
3. Learn and identify the concepts of a standard solutions, primary and secondary standards
4. Facilitate the learner to make solutions of various molar concentrations.

V. Syllabus:

Volumetric analysis:

1. Estimation of sodium hydroxide using standardised HCl solution.
2. Estimation of sodium carbonate and sodium hydroxide present in a mixture.
3. Determination of Fe (II) using KMnO_4 with oxalic acid as primary standard. (internal indicator method)
4. Determination of Fe (II) using KmnO_4 with oxalic acid as primary standard. (external indicator method)
5. Estimation of water of crystallization in Mohr's salt by titrating with KmnO_4

VI. Co-curricular activities and assessment methods :

1. Continuous Evaluation: Monitoring the progress of student's learning
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VII. List of reference books:

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Single Major B.Sc Chemistry (w.e.f:2023-24A.B)

IV - SEMESTER

Course Code 11: Nitrogen containing Organic Compounds & Spectroscopy

Credits: 03

Nitrogen containing Organic Compounds & Spectroscopy

I. Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Distinguish primary secondary and tertiary amines and their properties.
2. Describe the preparation and properties of amino acids.
3. Explain the reactivity of nitro hydrocarbons.
4. Discuss heterocyclic compounds with N, O and S.
5. Apply the concepts of UV and IR to ascertain the functional group in an organic compound.

II. Syllabus:

Unit I Amines: (9 h)

Classification, chirality in amines (pyramidal inversion), preparations – Gabriel synthesis, Hoffmann- Bromamide reaction (with mechanism), reduction of amides and Schmidt reaction. Distinction between Primary, secondary and tertiary amines using Hinsberg's method and nitrous acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Carbylamine reaction, Hoffmann's exhaustive methylation, Hofmann and Cope elimination.

Diazonium Salts: Preparation and synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds. Coupling reactions of diazonium salts (preparation of azo dyes).

UNIT- II Amino acids (9 h)

Definition and classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: a) from halogenated carboxylic acid, b) Gabriel Phthalimide synthesis c) Strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating-peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.



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UNIT- III Nitro hydrocarbons (9h)

Nomenclature and classification, structure -Tautomerism of nitroalkanes leading to acid and keto form, Preparation of Nitroalkanes, reactivity - halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Micheal addition and reduction.

Unit IV Heterocyclic Compounds (9 h)

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan, Thiophene and Pyrrole - Aromatic character – Preparation from 1, 4, -dicarbonyl compounds, Paul-Knorr synthesis. Properties: Acidic character of pyrrole - electrophilic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation - Diels Alder reaction in furan. Pyridine – synthesis - Aromaticity -Basicity - Comparison with pyrrole- one method of preparation and properties - Reactivity towards Nucleophilic substitution reaction.

Unit V UV-Visible & IR Spectroscopy (9 h)

Selection rules for electronic spectra, types of electronic transitions in molecules, concept of chromophore and auxochrome, effect of conjugation- Woodward Fischer rules for calculating

λ_{max} of conjugated dienes and α,β unsaturated compounds. Infrared spectroscopy and types of molecular vibrations and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intra molecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on $>\text{C}=\text{O}$ stretching absorptions).

III. List of Reference Books

- 1) A Text Book of Organic Chemistry by Bahl and Arunbahl
- 2) A Text Book of Organic chemistry by I L Finar Vol I
- 3) Organic chemistry by Bruice
- 4) Organic chemistry by Clayden
- 5) Spectroscopy by William Kemp
- 6) Spectroscopy by Pavia
- 7) Organic Spectroscopy by J. R. Dyer
- 8) Elementary organic spectroscopy by Y.R. Sharma
- 9) Spectroscopy by P.S.Kalsi
- 10) Spectrometric Identification of Organic Compounds by Robert M Silverstein, Francis X Webster



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IV - SEMESTER

Course Code 11: Organic preparations and IR Spectral Analysis

Credits: 01

Organic preparations and IR Spectral Analysis

Course outcomes:

On completion of the course, the student will be able to:

- 11) Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
- 12) Calculate limiting reagent, theoretical yield, and percent yield
- 13) Engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents appropriately
- 14) Dispose of chemicals in a safe and responsible manner
- 15) Perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
- 16) Create and carry out work up and separation procedures.

Syllabus:

A. Organic preparations: 40M

- 1) Acetylation of one of the following compounds: amines (aniline, o-, m-, ptoluidines and o-, m-, p-anisidine)
 - a. Using conventional method.
 - b. Using green approach
- 2) Benzoylation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine)
- 3) Nitration of any one of the following:
Acetanilide/nitrobenzene by conventional method

B.IR Spectral Analysis 10M

IR Spectral Analysis of the following functional groups with examples a) Hydroxyl groups b) Carbonyl groups c) Amino groups d) Aromatic groups



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List of reference books:

1. Vogel A.I .Practical Organic Chemistry, Longman Group Ltd.
2. Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3. Ahluwalia V. K. and Agarwal R. Comprehensive Practical Organic Chemistry, University press.
4. Web related references suggested by teacher.