

B.Sc., III YEAR CHEMISTRY

SEMESTER-V

DSE-A: Chemistry Paper-V

(Spectroscopy & Chromatography)

(04 credits)

60 Hrs (04 Hrs/week)

UNIT-I: Molecular Spectroscopy (15 Hrs)

S5-A-E-I: Introduction to electromagnetic radiation, interaction of electromagnetic radiations with molecules, various types of molecular spectra.

Rotational spectroscopy (Microwave spectroscopy)

Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules eg. HCl.

Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant (Problems). Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum

Electronic spectroscopy

Bonding and anti-bonding molecular orbitals, electronic energy levels of molecules (σ , π , n), types of electronic transitions: σ - σ^* , n - σ^* , n - π^* , π - π^* with suitable examples. Selection rules, Terminology of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption characteristics of chromophones: diene, enone and aromatic chromophores. Representation of UV-Visible spectra. General features of absorption-spectroscopy transmittance, absorbance, and molar absorptivity. Beer-Lambert's law and its limitations.

UNIT-II: NMR & Mass Spectroscopy (15 Hrs)

S5-A-E-II: Proton Magnetic Resonance Spectroscopy

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, factors affecting chemical shifts, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations. ^1H NMR spectrum of – ethyl bromide, acetaldehyde, 1, 1, 2- tribromo ethane, ethyl acetate and acetophenone.

Mass Spectrometry

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular formula. Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

UNIT-III: Separation techniques-I (15 Hrs)

S5-A-E-III: Solvent Extraction- Principle, Methods of extraction: Batch extraction, continuous extraction and counter current extraction. Application– Determination of Iron (III).

Chromatography: Classification of chromatographic methods, principles of differential migration, adsorption phenomenon, nature of adsorbents, solvent systems.

Thin layer Chromatography (TLC): Advantages, preparation of plates, solid phase and mobile phase used in TLC, eluotropic series, development of the chromatogram, Detection of the spots, factors effecting R_f values and applications of TLC.

Paper Chromatography: Principle, choice of paper and solvent systems, development of chromatogram – ascending, descending, radial and two dimensional chromatography, detection of spots, and applications of paper chromatography.

UNIT-IV: Separation techniques-II (15 Hrs)

S5-A-E-IV: Column Chromatography- Principle, Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

Ion exchange chromatography: Principle, cation and anion exchange resins, its application in separation of ions, de-ionized water.

Gas Chromatography: Principle, theory and instrumentation (Block Diagram), Types of stationary phases and carrier gases (mobile phase), application of GC.

High performance liquid chromatography: Principle, theory and instrumentation, stationary phases and mobile phases. Applications of HPLC, analysis of Paracetamol.

Recommended Text Books and Reference Books:

1. Fundamentals of Molecular Spectroscopy, C.N. Ban well & Mc Cash.
2. Organic spectroscopy, William Kemp, Palgrave Macmillan; 2nd Revised edition.
3. Spectroscopy, B K Sharma Krishna Prakashan Media, 1981.
4. Elements of Organic spectroscopy, YR Sharma.
5. Applications of Absorption spectroscopy of Organic compounds (English paper back, Dyer R.John)
6. Organic chemistry, Morrison and Boyd, Pearson Publications.
7. Introduction to Spectroscopy by Donald Pavia, Gary Lampman and George Kriz. Saunders College Division, 2001.
8. Chemistry text book for B.Sc., published by Telugu academy, Govt. of Telangana.
9. Analytical Chemistry by David Krupadanam, Universities Press (India) Limited.
10. Principles of Instrumental Analysis, D.A.Skoog, F.J.Holler & T.A. Nieman, Cengage Learning India Ed.
11. Fundamentals of Analytical Chemistry 6th Edn, D.A.Skoog, D.M. West, F.J.Holler, Saunders College Publishing, Fort worth (1992).
12. Instrumental Methods of Analysis, 7th Ed. Willard, H.H., Merritt, L.L., Dean, J. & Settle, F.A. Wordsworth Publishing Co.Ltd., Belmont, California, USA, 1988.
13. A Text Book of Quantitative Inorganic Analysis 7th Ed., Vogel, A.I. Prentice Hall.
14. Analytical Chemistry 7 th Edition by Gary D.Christian (2004)
15. Separation Methods, M.N Sastry, Himalaya Publication (2004)

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SEMESTER-V

DSE-B: Chemistry Paper-V

(Metallurgy, Dyes and Catalysis)

(04 credits)

60 Hrs (04 Hrs/week)

Unit I: General Principles of Metallurgy and Production of Non Ferrous Metals (15 Hrs)

S5-E-B-I: Pyrometallurgy: Drying and calcination, roasting, smelting, products of smelting,

Hydrometallurgy: Leaching methods, leaching agents, leaching of metals, oxides and sulphides.

Separation of liquid and solid phases and processing of aqueous solutions

Electrometallurgy: Electrolysis, Refining electrolysis, electrolysis from aqueous solutions, fused-salt electrolysis

Refining processes: Chemical and physical refining processes

Production of selected non-ferrous metals (Copper, Nickel, Zinc): Properties, raw materials, production (flow charts presentations and chemical reactions involved) and uses.

Unit II: Natural and Synthetic Dyes (15 Hrs)

S5-E-B-II: Definition and Classification of dyes - Natural dyes, Synthetic dyes: based on chemical constitution of dyes; Chemical nature of dyes; Application of dyes.

Structures of Natural dyes: Indigo, Tyrian purple, Alizarine, Indigotin.

Structures of Synthetic dyes: Nitro dyes, Nitroso dyes, Azo dyes (Mono azo dye, Bis azo dyes) Diaryl methane dyes, Triaryl methane dyes, Xanthenes dyes, Phenolphthalein, Fluoroseine, Acridine dyes.

Synthesis of dyes: Mono azo dye, Bis azo dyes (Congo red), Auromine O, Malachite Green, Crystal Violet, Rhodamine B, Acridine Yellow, Indigotin. Binding of dyes to fabric. Applications of dyes.

Unit III: Catalysis-I (15 Hrs)

S5-E-B-III: Homogeneous and heterogeneous catalysis - Definition of a catalyst and catalysis. Comparison of homogeneous and heterogeneous catalysis with specific examples. General characteristics of catalytic reactions.

Acid-base catalysis- Examples of acid and base catalysed reactions, hydrolysis of esters. Kinetics of acid catalysed reactions. Specific acid and general acid catalysis, Kinetics of base catalysed reactions. Specific base and general base catalysis. Examples- Aldol condensation and decomposition of nitramide, base catalysed conversion of acetone to di acetone alcohol, Mutarotation of Glucose. Effect of pH on reaction rate of acid and base catalysed reactions.

Phase transfer catalysis: Principle of phase transfer catalysis, classification of phase transfer catalysts. Factors influencing the rate of PTC reactions.

Unit IV: Catalysis-II (15 Hrs)

S5-E-B-IV: Enzyme catalysis- Characteristics of enzyme catalysis, Examples: (i) Invertase in inversion of cane sugar (ii) Maltase in conversion of maltose to glucose (iii) Urease in decomposition of urea (iv) Zymase in conversion of glucose to ethanol (v) working of carbonic anhydrase and (vi) Mechanism of oxidation ethanol by alcohol dehydrogenase. Factors affecting enzyme catalysis. Effect of temperature, pH, concentration and effect of inhibitor on enzyme catalysed reactions, Catalytic efficiency.

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Kinetics of enzyme catalysed reactions: Michaelis-Menton Equation. Mechanism of enzyme catalysed reactions. Significance of Michaelis constant (K_m) and maximum velocity (V_{max}), Lineweaver-Burk plot. Types of enzyme inhibitors.

Recommended Text Books and Reference Books:

1. Industrial Chemistry B.K.Sharma
2. Engineering Chemistry, Jain and Jain
3. Industrial Chemistry, E. Stocchi, Vol-I, Ellis Horwood Ltd. UK.
4. Handbook of Industrial Chemistry, J. A. Kent: Riegel's, CBS Publishers, New Delhi.
5. Theory of production of non-ferrous metals and alloys Study. Kateřina Skotnicová, Monika Losertová, Miroslav Kursa.
6. The Chemistry of Synthetic Dyes, Volume 4, K.Venkataraman, Elsevier.
7. Organic Chemistry Vol-I by I.L. Finar.
8. Organic Chemistry by Jennice, Gorzinski Smith.
9. Natural Dyes: Sources, Chemistry, Application and Sustainability Issues by Sujata Saxena and A. S. M. Raja.
10. Physical Chemistry by Atkins and De Paula, 8 th Edn.
11. Physical Chemistry by Puri, Sharma and Pattania, 2017.
12. Kinetics and mechanism of chemical transformations by Rajarajm and Kuriacose, Published by Macmillan India Ltd.
13. Text book of Physical Chemistry by K.L. Kapoor Macmillan, 1999.
14. Catalysis by J.C. Kuriacose, Macmillan Publishers India Limited, 1980.
15. Phase Transfer Catalysis, Fundamentals, Applications and Industrial perspectives, C.M.Stark, C.Liotta & M.Halpern, Academic Press.
16. Phase Transfer Catalysis, E.V.Dehmlow & S.S. Dehmlow, Verlag Chemie, Weinheim.

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B.Sc., III YEAR CHEMISTRY

SEMESTER-V

LABORATORY COURSE

Paper –V: Experiments in Physical Chemistry-I

(01 Credit)

45 Hrs (03 Hrs/week)

1. Distribution law

- a) Determination of molecular status and partition coefficient of benzoic acid in Toluene and water.
- b) Determination of distribution coefficient of acetic acid between n-butanol and water.

2. Electrochemistry

- a) Determination of cell constant of conductivity cell.
- b) Verification of Ostwald's dilution law- Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.

3. Colorimetry

- a) Verification of Beer's - Lamberts law for $KMnO_4$
- b) Determination of the concentration of the given $KMnO_4$ solution.

4. Adsorption

- a) Adsorption of acetic acid on animal charcoal- Verification of Freundlich adsorption isotherm.

5. Physical constants

- a) Surface tension and b) Viscosity of liquids. (Demonstration Experiment)

Reference books:

1. Senior Practical Physical Chemistry, B. D Khosla, V. C. Garg, Adarsh Gulati Published by R. Chand & Co.
2. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghavan. Viva Books.
3. Practicals in Physical Chemistry by P.S. Sindhu ISBN-10: 1-4039-2916-5/1403929165 ISBN-13: 978-1-4039-2916-7/9781403929167.





