



**Rayat Shikshan Sanstha's
KARMAVEER BHURAO PATIL COLLEGE, VASHI. NAVI
MUMBAI**

(AUTONOMOUS COLLEGE)

Sector-15- A, Vashi, Navi Mumbai - 400 703

Syllabus for T.Y.B.Sc. Chemistry

Program: Bachelor of Science

Course: T.Y.B.Sc. Chemistry

2023-24

Course Code	Unit	Topics	Credits	L/Week (Hrs)
UGCHDSE501 (Physical Chemistry)	I	MOLECULAR SPECTROSCOPY	4	4
	II	CHEMICAL THERMODYNAMICS		
	III	NUCLEAR CHEMISTRY		
	IV	SURFACE CHEMISTRY		
UGCHDSE502 (Inorganic Chemistry)	I	MOLECULAR SYMMETRY AND CHEMICAL BONDING	4	4
	II	SOLID STATE CHEMISTRY		
	III	CHEMISTRY OF INNER TRANSITION ELEMENTS		
	IV	SOME SELECTED TOPICS		
UGCHDSE503 (Organic Chemistry)	I	MECHANISM OF ORGANIC REACTIONS, PHOTOCHEMISTRY	4	4
	II	STEREOCHEMISTRY-I, CARBANIONS AND THEIR REACTIONS HETEROCYCLIC CHEMISTRY		
	III	IUPAC, SYNTHESIS OF ORGANIC COMPOUNDS		
	IV	SPECTROSCOPY-I, NATURAL PRODUCTS		
UGCHSEC 504A (Analytical Chemistry)	I	INTRODUCTION TO QUALITY CONCEPTS, CHEMICAL, SPECTROPHOTOMETRY AND ELECTROPHORESIS	3	3
	II	CLASSICAL METHODS OF ANALYSIS (TITRIMETRY)		
	III	OPTICAL METHODS		
	IV	METHODS OF SEPERATION		
UGCHSEC504B (Chemistry of Dyes)	I	INTRODUCTION TO DYE STUFF INDUSTRY	3	3
	II	CLASSIFICATION OF DYES AND NON-TEXTILE USES OF DYES		
	III	CHEMISTRY OF DYE INTERMEDIATES AND DYEING METHODS		
	IV	HEALTH AND ENVIRONMENTAL HAZARDS OF SYNTHETIC DYES		
	IV	ESSENTIAL OIL AND THEIR IMPORTANCE		
Note: Student should select any one course as SEC				

UGCHDSE 5P1		Physical Chemistry Practical	2	4
UGCHDSE 5P2		Inorganic Chemistry Practical	2	4
UGCHDSE 5P3		Organic Chemistry Practical	2	4
UGCHSEC 5P4A		Analytical Chemistry Practical	1	2
UGCHSEC 5P4B		Chemistry of Dyes Practical	1	2

Semester VI

Course Code	Unit	Topics	Credits	L/week
UGCHDSE601 (Physical Chemistry)	I	ELECTROCHEMISTRY	4	4
	II	POLYMERS		
	III	BASICS OF QUANTUM CHEMISTRY		
	IV	NMR -NUCLEAR MAGNETIC RESONANCE		
UGCHDSE602 (Inorganic Chemistry)	I	THEORIES OF THE METAL-LIGAND BOND (I)	4	4
	II	THEORIES OF THE METAL-LIGAND BOND (II)		
	III	ORGANOMETALLIC CHEMISTRY		
	IV	SOME SELECTED TOPICS		
UGCHDSE603 (Organic Chemistry)	I	STEREOCHEMISTRY II, AMINO ACIDS & PROTEINS	4	4
	II	MOLECULAR REARRANGEMENTS & CARBOHYDRATES		
	III	SPECTROSCOPY & NUCLEIC ACIDS		
	IV	POLYMER.CATALYSTS AND REAGENTS		
UGCHSEC604A (Analytical Chemistry)	I	ELECTRO ANALYTICAL TECHNIQUES	3	3
	II	METHODS OF SEPARATION - II		
	III	FOOD AND COSMETICS ANALYSIS		
	IV	THERMAL METHODS AND ANALYTICAL METHOD VALIDATION		
UGCHSEC604B (Chemistry of Drugs)	I	GENERAL INTRODUCTION OF DRUGS	3	3
	II	DRUG DISCOVERY, DESIGN AND DEVELOPMENT		

	III	SYNTHESIS OF DRUGS AND THEIR INTERMEDIATES		
	IV	APPLICATIONS OF DRUGS		
Note: Student should select any one course as SEC.				
UGCHDSE 6P1		Physical Chemistry Practical	2	4
UGCHDSE 6P2		Inorganic Chemistry Practical	2	4
UGCHDSE 6P3		Organic Chemistry Practical	2	4
UGCHSEC 6P4A		Analytical Chemistry Practical	1	2
UGCHSEC 6P4B		Chemistry of Drugs Practical	1	2
Total Credits				

UGCHDSE501 Physical Chemistry

UNIT I	MOLECULAR SPECTROSCOPY	15L
	<p>MOLECULAR SPECTROSCOPY</p> <p>1.1 Rotational Spectrum: Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, .Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift.</p> <p>1.2 Vibrational spectrum: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum.</p> <p>1.3 Vibrational-Rotational spectrum of diatomic molecule: energy levels, selection rule, nature of spectrum, P and R branch lines. A harmonic oscillator energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H₂O and CO₂.</p> <p>1.4 Raman Spectroscopy: Scattering electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO₂ molecule</p>	

UNIT II	CHEMICAL THERMODYNAMICS	15L
	<p>2.1 CHEMICAL THERMODYNAMICS</p> <p>2.1.1 Colligative properties: Vapor pressure and relative lowering of vapor pressure. Measurement of lowering of vapor pressure - Static and Dynamic method.</p> <p>2.1.2 Solutions of Solid in Liquid:</p> <p>2.1.2.1 Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute.</p> <p>2.1.2.2 Depression in freezing point of a solution, thermodynamics derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute. Beckmann Method and Rast Method.</p> <p>2.1.3 Osmotic Pressure: Introduction, thermodynamic derivation of Van't Hoff equation, Van't Hoff Factor. Measurement of Osmotic Pressure - Berkeley and Hartley's Method, Reverse osmosis.</p> <p>2.2 Chemical Kinetics</p> <p>2.2.1 Collision theory of reaction rates: Application of collision theory to 1. Unimolecular reaction Lindemann theory and 2. Bimolecular reaction. (Derivation expected for both)</p> <p>2.2.2 Classification of reactions as slow, fast and ultra -fast. Study of kinetics of fast reactions by Stop flow method and Flash photolysis (No derivation expected).</p>	
Unit III	NUCLEAR CHEMISTRY	15
	<p>NUCLEAR CHEMISTR</p> <p>3.1 Introduction: Basic terms-radioactive constants (decay constant, half-life and average life) and units of radioactivity</p> <p>3.2 Detection and Measurement of Radioactivity: Types and characteristics of nuclear radiations, behavior of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter.</p> <p>3.3 Application of use of radioisotopes as Tracers: chemical reaction mechanism, age determination - dating by C¹⁴.</p> <p>3.4 Nuclear reactions: nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy.</p> <p>3.5 Fission Process: Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process. Multiplication factor and critical size or mass of fissionable material, nuclear power reactor and breeder reactor.</p> <p>3.6 Fusion Process: Thermonuclear reactions occurring on stellar bodies and earth.</p>	

UNIT IV	SURFACE CHEMISTRY	15
	<p>4.1. SURFACE CHEMISTRY</p> <p>4.1.1 Adsorption: Physical and Chemical Adsorption, types of adsorption isotherms. Langmuir's adsorption isotherm (Postulates and derivation expected). B.E.T. equation for multilayer adsorption, (derivation not expected). Determination of surface area of an adsorbent using B.E.T. equation.</p> <p>4.2 Colloidal State</p> <p>4.2.1 Introduction to colloids - Emulsions, Gels and Sols</p> <p>4.2.2 Electrical Properties: Origin of charges on colloidal particles, Concept of electrical double layer, zeta potential, Helmholtz and Stern model. Electro-kinetic phenomena - Electrophoresis, Electro-osmosis, Streaming potential, Sedimentation potential; Donnan Membrane Equilibrium.</p> <p>4.2.3 Colloidal electrolytes: Introduction, micelle formation</p> <p>4.2.4 Surfactants: Classification and applications of surfactants in detergents and food industry.</p>	

References

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkata.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa - Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
- 10.Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
- 11.Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd.,

Singapore, 2007.

12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.

13. Essentials of Nuclear Chemistry, Arnika, Hari Jeevan, New Age International (P) Ltd., Publishers, 2011.

14. Chemical Kinetics, K. Laidler, Pearson Education India, 1987.

Paper II UGCH502 INORGANIC CHEMISTRY

UNIT I	Molecular Symmetry and Chemical Bonding	15 L
	Molecular Symmetry and Chemical Bonding 1.1 Molecular Symmetry 1.1.1 Introduction and Importance of Symmetry in Chemistry. 1.1.2 Symmetry elements and Symmetry operations. 1.1.3 Concept of a Point Group with illustrations using then following point groups: (i) C _{2v} (ii) D _{2h} (iii) C _{2v} (iv) C _{3v} (v) C _{2h} and (vi) D _{3h} 1.2 Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species 1.2.1 Comparison between homonuclear and heteronuclear diatomic molecules. 1.2.2 Heteronuclear diatomic molecules like CO, NO and HCl, appreciation of modified MO diagram for CO. 1.2.3 Molecular orbital theory for H ₃ and H ₃ ⁺ (correlation diagram expected). 1.2.4 Molecular shape to molecular orbital approach in AB ₂ molecules. Application of symmetry concepts for linear and angular species considering σ - bonding only. (Examples like: i) BeH ₂ , ii) CO ₂ .	
Unit II	SOLID STATE CHEMISTRY 2.1 Structures of Solids 2.2.1 Explanation of terms viz. crystal lattice, lattice point, unit cell and lattice constants. 2.1.2 Closest packing of rigid spheres (hcp, ccp), packing density in simple cubic, bcc and fcc lattices. Relationship between density, radius of unit cell and lattice parameters. 2.1.3 Stoichiometric Point defects in solids (discussion on Frenkel and Schottky defects expected). 2.2 Superconductivity 2.2.1 Discovery of superconductivity. 2.2.2 Explanation of terms like superconductivity, transition temperature, Meissner effect.	

	<p>2.2.3 Different types of super conductors viz. conventional superconductors, alkali metal fullerides, high temperature super conductors.</p> <p>2.2.4 Brief application of superconductors.</p>	
Unit III	<p>CHEMISTRY OF INNER TRANSITION ELEMENTS (15)</p> <p>3.1 Introduction: Position in periodic table and electronic configuration of lanthanides and actinides.</p> <p>3.2 Chemistry of Lanthanides with reference to (i) lanthanide contraction and its consequences (ii) Oxidation states (iii) Ability to form complexes (iv) Magnetic and spectral properties</p> <p>3.3 Occurrence, extraction and separation of lanthanides by (i) Ion Exchange method and (ii) Solvent extraction method (Principles and technique)</p> <p>3.4 Applications of lanthanides</p>	
Unit IV	<p>4.1 Chemistry of Non-aqueous Solvents</p> <p>4.1.1 Classification of solvents and importance of non-aqueous solvents.</p> <p>4.1.2 Characteristics and study of liquid ammonia, Acetic Acid as non-aqueous solvents with respect to : (i) acid-base reactions and (ii) redox reactions.</p> <p>4.2 Comparative Chemistry of Group 16</p> <p>4.2.1 Electronic configurations, trends in physical properties, allotropy</p> <p>4.2.2 Manufacture of sulphuric acid by Contact process.</p> <p>4.3 Comparative Chemistry of Group 17</p> <p>4.3.1 Electronic configuration , General characteristics, anomalous properties of fluorine, comparative study of acidity of oxyacids of chlorine w.r.t acidity, oxidising properties and structures (on the basis of VSEPR theory)</p> <p>4.3.2 Chemistry of interhalogens with reference to preparations, properties and structures (on the basis of VSEPR theory)</p>	
<p>References: Unit-I</p> <ol style="list-style-type: none"> 1. Per Jensen and Philip R. Bunker , Fundamentals of Molecular Symmetry , Series in Chemical Physics, Taylor & Francis Group 2. J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press 3. Derek W. Smith, Molecular orbital theory in inorganic chemistry Publisher: Cambridge University Press 4. C. J. Ballhausen, Carl Johan Ballhausen, Harry B. Gray Molecular Orbital Theory: 		

An Introductory Lecture Note and Reprint Volume Frontiers in chemistry
Publisher W.A. Benjamin, 1965

5. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
6. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd

Unit-II

1. Lesley E. Smart, Elaine A. Moore Solid State Chemistry: An Introduction, 2nd Edition CRC Press
2. C. N. R. Rao Advances in Solid State Chemistry
3. R.G. Sharma Superconductivity: Basics and Applications to Magnets
4. Michael Tinkham ,Introduction to Superconductivity: Vol I (Dover Books on Physics)
5. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
6. Richard Harwood, Chemistry, Cambridge University Press.
7. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd .

Unit-III

1. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
2. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann 1997.
3. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
4. G. Singh, Chemistry of Lanthanides and Actinides, Discovery Publishing House
5. Simon Cotton , Lanthanide and Actinide Chemistry Publisher: Wiley-Blackwell

Unit-IV

1. B. H. Mahan, University Chemistry, Narosa publishing.
2. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
3. J. D. Lee, Concise Inorganic Chemistry, 4thEdn., ELBS,
4. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
5. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
6. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt.,Ltd. (2002).
7. Richard Harwood, Chemistry, chapter 10 Industrial inorganic chemistry
8. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann 1997.
9. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993
10. Satya Prakash, G.D.Tuli, R.D. Madan , Advanced Inorganic Chemistry.S. Chand & Co Ltd 2004

UNIT I	<p>1.1 Mechanism of organic reactions</p> <p>Determining mechanism of a reaction: Product analysis, Kinetic studies, Stereochemical outcome, Detection and trapping of intermediates, Crossover experiments, Kinetic isotope effect –primary kinetic & secondary kinetic isotope effect.</p> <p>1.1.1 Neighbouring group participation in nucleophilic substitution reactions: participation of lone pair of electrons, kinetics and stereochemical outcome. 1.1.3 Mechanism and synthetic applications: Claisen condensation, Michael addition.</p> <p>1.1.4 Pericyclic reactions, classification and nomenclature .</p> <p>1.1.4.1 Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type).</p> <p>1.1.4.2 Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates.</p> <p>1.2 Photochemistry</p> <p>1.2.1 Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization.</p> <p>1.2.2. Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4-dienes (di-π methane).</p> <p>1.2.3. Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol)</p>	
UNIT II	<p>2.1. Stereochemistry I</p> <p>2.1.1 Stereo selectivity and Stereo specificity: Idea of enantioselectivity (ee) and diastereoselectivity (de). Topicity-enantiotopic and diastereotopic atoms, groups and faces.</p> <p>2.1.2 Chirality of compounds without a stereo genic center: cummulenes and biphenyls.</p> <p>2.2. Carbanions and their reactions</p> <p>Introduction, Formation and stability of Carbanion. Reactions involving carbanions and their mechanisms: Aldol, Claisen, Dieckmann and Perkin condensations. Synthesis and Synthetic applications of Malonic ester, Acetoacetic ester and Wittig reagent.</p> <p>2.3. Heterocyclic chemistry:</p> <p>2.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quinoline.</p> <p>2.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline(BischlerNapieralski synthesis).</p> <p>2.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $\text{NaNH}_2/\text{liq. NH}_3$, n-BuLi.</p> <p>2.3.4 Reactions of quinoline and isoquinoline; oxidation, reduction, nitration, halogenation and reaction with $\text{NaNH}_2/\text{liq. NH}_3$, n-BuLi.</p>	15
UNIT III	<p>3.1 IUPAC</p> <p>IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups):</p>	15

	<p>3.1.1. Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds.</p> <p>3.1.2. Biphenyls</p> <p>3.1.3. Cummulenes with upto 3 double bonds</p> <p>3.1.4. Quinolines and isoquinolines</p> <p>3.2 Synthesis of organic compounds</p> <p>3.2.1 Green chemistry and synthesis: Introduction: Twelve principles of green chemistry, concept of atom economy and E-factor, calculations and their significance, numerical examples. Use of following in the green synthesis</p> <ul style="list-style-type: none"> i) Green reagents: dimethyl carbonate. ii) Green starting materials : D-glucose iii) Green solvents : supercritical CO₂ iv) Green catalysts: Bio catalysts. <p>3.2.2. Multicomponent Synthesis with examples (no mechanism) : Mannich reaction , Biginelli reaction. Ugi -4CC- reaction Synthesis</p> <p>3.2.3. Use of PTC, crown ether , ultrasound, and solid supported reagents in the green synthesis</p>	
UNIT IV	<p>4.1 Spectroscopy I</p> <p>4.1.1. UV – Visible spectroscopy: Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interactions.</p> <p>4.1.2. Calculation of absorption maxima for dienes, conjugated polyenes (cyclic and acyclic), carbonyl and unsaturated carbonyl compounds, substituted aromatic compounds by Woodward-Fieser rules (using Woodward-Fieser tables for values for substituents).</p> <p>4.1.3 Mass spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds.</p> <p>4.2. Natural Products:</p> <p>4.2.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule.</p> <p>4.2.2 Citral: a) Structural determination of citral. b) Synthesis of citral from methyl heptenone.</p> <p>4.2.3. Alkaloids Introduction and occurrence. Hofmann’s exhaustive methylation and degradation in: N – substituted monocyclic amines.</p>	15

	<p>4.2.4 Nicotine: Synthesis of nicotine from nicotinic acid , Harmful effects of nicotine.</p> <p>4.2.5. Hormones: Introduction, structure of adrenaline (epinephrine), physiological action of adrenaline. Synthesis of adrenaline from a) Catechol b) p-hydroxybenzaldehyde (Ott's synthesis) , structure of Thyroxine and its physiological action</p>	
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References: Unit I

1. A guidebook to mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson Education, New Delhi
2. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
3. Organic reactions & their mechanisms, 3rd revised edition, P.S. Kalsi, New Age International Publishers.
4. M.B. Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.
6. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
7. Organic chemistry, 8th edition, John McMurry

References: Unit II

1. L. Eliel , stereochemistry of carbon compounds, Tata McGraw Hill
2. Stereochemistry P.S.Kalsi , New Age International Ltd., 4th Edition
3. Stereochemistry by Nassipuri.
4. Insecticides & pesticides: Saxena A. B., Anmol publication.
5. Growth regulators in Agriculture & Horticulture: Amarjit Basra, CRC press 2000.
6. Agrochemicals and pesticides: A. Jadhav and T.V. Sathe.
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References: Unit III

1. Nomenclature of Organic Chemistry: IUPAC recommendations and preferred Names 2013, RSC publication.
2. IUPAC nomenclature by S. C. Pal.
3. Green chemistry an introductory text : Mike Lancaster.
4. Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
5. Green chemistry an introductory text : RSC publishing.
6. New trends in green chemistry V. K. Ahluwalia , M. Kidwai, Klumer Academic publisher
7. Green chemistry by V. Kumar. 6. Organic chemistry: Francis Carey
8. Organic chemistry: Carey and Sundberg.

References: Unit IV

1. Organic spectroscopy (Second edition), Jag Mohan, Narosa publication
2. Spectroscopy, Pavia, Lampman, Kriz, Vyvyan.
3. Elementary organic spectroscopy (Third edition), Y.R. Sharma, S. Chand publication..
4. Introduction to spectroscopy (third edition), Pavia Lampman, Kriz, Johnvondeling Emily Barrosse.
5. Organic chemistry Paula Y. Bruice, Pearson education.
6. Spectral identification of organic molecules by Silverstein. 7. Absorption spectroscopy of organic molecules by V.M. Parikh.
7. Chemistry of natural products by Chatwal Anand – Vol I and Vol II
8. Chemistry of natural products by O.P. Agarwal
9. Chemistry of natural products by Meenakshi Sivakumar and Sujata Bhat.
10. Organic chemistry by Morrison and Boyd, 7th edition.
11. Organic chemistry by I. L. Finar, Vol-I, and Vol-II, 5th edition

UGCHDSE504 Analytical Chemistry

UNIT I	1.1 Quality in Analytical Chemistry 1.1.1 Concepts of Quality, Quality Control and Quality Assurance 1.1.2 Importance of Quality concepts in Industry 1.1.3 Chemical Standards and Certified Reference Materials; Importance in chemical analysis and Quality of material: Various grades of laboratory reagents 1.2 Introduction to Spectrophotometry Instrumentation of single beam colorimeter, Instrumentation of single and double beam spectrophotometer, Principle of additivity of absorbance and simultaneous determination, Spectrophotometric Titrations, Experimental Applications-Structure of organic compounds, Structure of complexes, Numerical Problems 1.3 Electrophoresis Introduction, Principle and theory of electrophoresis, Different types of electrophoresis techniques, Moving Boundary Electrophoresis, Zone electrophoresis- Paper, Cellulose acetate and Gel electrophoresis, Applications of electrophoresis	15
UNIT II	2.1 Redox Titrations (Numerical and word Problems are expected) 2.1.1 Introduction 2.1.2 Construction of the titration curves and calculation of E_{system} in aqueous medium in case of: (1) One electron system (2) Multielectron system 2.1.3 Theory of redox indicators, Criteria for selection of an indicator. Use of diphenyl amine and ferroin as redox indicators 2.2 Complexometric Titrations 2.2.1 Introduction, construction of titration curve 2.2.2 Use of EDTA as titrant and its standardization absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity with examples.	15

	<p>Advantages and limitations of EDTA as a titrant.</p> <p>2.2.3 Types of EDTA titrations.</p> <p>2.2.4 Metallochromic indicators, theory, examples and applications</p>	
UNIT III	<p>3.1 Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy (AAS)</p> <p>3.1.1 Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra</p> <p>3.1.2 Flame Photometry - Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors)</p> <p>3.1.3 Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser)</p> <p>3.1.4 Quantification methods of FES and AAS - Calibration curve method, Standard addition method and Internal standard method.</p> <p>3.1.5 Comparison between FES and AAS</p> <p>3.1.6 Applications, Advantages and Limitations, (specific applications from Vogel book Problems based on AAS and FES)</p> <p>3.1.7 Interference in AAS/FES methods</p> <p>3.2 Molecular Fluorescence and Phosphorescence Spectroscopy (4)</p> <p>3.2.1 Introduction and Principle</p> <p>3.2.2 Relationship of Fluorescence intensity with concentration</p> <p>3.2.3 Factors affecting Fluorescence and Phosphorescence</p> <p>3.2.4 Instrumentation and applications</p> <p>3.2.5 Comparison of Fluorimetry and Phosphorimetry</p> <p>3.2.6 Comparison with Absorption methods (Numerical Problems)</p> <p>3.3 Turbidimetry and Nephelometry (4)</p> <p>3.3.1 Introduction and Principle</p> <p>3.3.2 Factors affecting scattering of Radiation: Concentration, particle size, wavelength, refractive index</p> <p>3.3.3 Instrumentation and Applications</p>	15
UNIT IV	<p>METHODS OF SEPARATION - I (6)</p> <p>4.1 Solvent Extraction (6)</p> <p>4.1.1 Factors affecting extraction: Chelation, Ion pair formation and Solvation</p> <p>4.1.2 Graph of percent extraction versus pH. Concept of $[pH]_{1/2}$ and its significance (derivation not expected)</p> <p>4.1.3 Craig's counter current extraction: Principle, apparatus and applications</p> <p>4.1.4 Solid phase extraction: Principle, process and applications with special reference to water and industrial effluent analysis.</p> <p>4.1.5 Comparison of solid phase extraction and solvent extraction.</p> <p>4.1.6 Extracting reagents</p> <p>4.2 High Performance Liquid chromatography (HPLC)</p> <p>4.2.1 Introduction and Principle Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating</p>	15

	<p>pumps, screw driven- syringe type pumps, pneumatic pumps, advantages and disadvantages of each pump), Precolumn, Sample injection system, HPLC Columns, Detectors(UV - Visible detector, Refractive index detector), plate theory for Principal of HPLC,</p> <p>4.2.2 Qualitative and Quantitative Applications of HPLC</p> <p>4.3 High Performance Thin Layer Chromatography (HPTLC) (3)</p> <p>4.3.1 Introduction and Principle Stationary phase, Sample application and mobile phase</p> <p>4.3.2 Detectors a) Scanning densitometer- Components. Types of densitometer- Single beam and Double beam b) Fluorometric Detector</p> <p>4.3.3 Advantages, disadvantages and applications</p> <p>4.3.4 Comparison of TLC and HPTLC</p>	
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References:

1. 3000 solved problems in Chemistry, David E. Goldberg, PhD., Schaums Outline Unit/s: (1.2)
2. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002), Unit/s (1.1)
3. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001) Unit/s (1.3)
4. Analytical Chemistry, Gary D. Christian, 5th edition Unit/s (4.1, 4.2, 4.3)
5. Analytical Chemistry Skoog, West, Holler, 7th Edition: Unit/s (2.1)
6. Analytical Chromatography, Gurdeep R. Chatwal, Himalaya publication Unit/s (4.1, 4.2, 4.3)
7. Basic Concepts of Analytical Chemistry, by S M Khopkar, New Age International (p) Limited Unit/s (4.1, 4.2, 4.3)
8. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969 Unit/s (4.1, 4.2, 4.3)
9. Fundamentals of Analytical Chemistry by Skoog and West, 8th Edition Unit/s (4.1, 4.2, 4.3)
10. Handbook of quality assurance for the analytical chemistry laboratory, 2nd Edn., James P. Dux Van Nostrand Reinhold, 1990 Unit/s (1.1)
11. High Performance Thin Layer Chromatography by Dr P.D. Sethi, CBS Publisher and Distribution Unit/s (4.1, 4.2, 4.3)
12. High Performance Thin Layer Chromatography in Food analysis, by Prem Kumar, CBS Publisher and distributor Unit/s (4.1, 4.2, 4.3)
13. Instrumental methods of Analysis, by Dr Supriya S Mahajan, Popular Prakashan Ltd Unit/s (4.1, 4.2, 4.3)
14. Instrumental methods Of Analysis, by Willard Merritt Dean, 7th Edition, CBS Publisher and distribution Pvt Ltd Unit/s (3.1, 3.2, 3.3)
15. Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House Unit/s (4.1, 4.2, 4.3)
16. Principles of Instrumental Analysis, 5th Edition, By Skoog, Holler, Nieman Unit/s (4.1, 4.2, 4.3) (3.1, 3.2, 3.3)

17. Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press (2018) Unit/s (1.1)
18. Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995 Unit/s (1.1)
19. Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969 Unit/s (4.1,4.2,4.3)
20. Thin Layer Chromatography, A LAB. Handbook, Egon Stahl, Springer International Student

UGCHSEC505A Chemistry of Dyes

(credits-3)

1. Introduction to the dye-stuff Industry (5)

1.1 Dyes

Definition of dyes, requirements of a good dye i.e. Colour, Chromophore and Auxochrome, Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability. Definition of fastness and its properties and Mordants with examples Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes - G, O, R, B, K, L, C, S H, 6B, GK, 6GK, Naming of dyes by colour index (two examples) used in dye industries.

1.1.1 Natural and Synthetic Dyes

Natural Dyes: Definition and limitations of natural dyes. Examples and uses of natural dyes w.r.t Heena, Turmeric, Saffron, Indigo, Madder, Chlorophyll -names of the chief dyeing material/s in each natural dye [structures not expected], Synthetic dyes: Definition of synthetic dyes, primaries and intermediates. Important milestones in the development of synthetic dyes - Emphasis on Name of the Scientist, dyes and the year of the discovery is required. (Structure is not expected).

1.2 Substrates for Dyes: Types of fibers (3)

1.2.1 Natural: cellulosic and proteinaceous fibres, examples - wool, silk and cotton structures and names of dyes applied on each of them.

1.2.2 Semi - synthetic: definition and examples [structures not expected]

1.2.3 Synthetic: Nylon, Polyesters and Polyamides structures and names of dyes applied on each of them

1.2.4 Blended fabrics: definition and examples [structures not expected]

1.2.5 Binding forces of dyes on substrate: ionic forces, covalent linkages, hydrogen bonding, vander-walls forces

1.3. Classification of dyes based on applications and dyeing methods (7)

1.3.1 Dyeing methods Basic Operations involved in dyeing process:

	<p>i. Preparation of fibres; ii. Preparation of dyebath; iii. Application of dyes iv. Finishing. Dyeing Method of Cotton Fibres: (i) Direct dyeing (ii) Vat dyeing (iii) Mordant dyeing; (iv) Disperse dyeing</p> <p>1.3.2 Classification of dyes based on applicability on substrates (examples with structures)</p> <p>(a) Acid Dyes- Orange II, (b) Basic Dyes-methyl violet, (c) Direct cotton Dyes- Benzofast Yellow 5GL (d) Azoic Dyes - Diazo components; Fast yellow G, Fast orange R. Coupling components. Naphthol AS, Naphthol ASG (e) Mordant Dyes-Eriochrome Black A, Alizarin. (f) Vat Dyes- Indanthrene brown RRD, (g) Sulphur Dyes- Sulphur Black T (no structure) (h) Disperse Dyes-Celliton Fast brown 3R, (i) Reactive Dyes- Cibacron Brilliant Red B,</p> <p>1.3.3 Optical Brighteners: General idea, important characteristics of optical brighteners and their classes [Stilbene, Coumarin, Heterocyclic vinylene derivatives, Diaryl pyrazolines, Naphthylamide derivatives] general structure of each class.</p>	
	<p>2.1 Color and Chemical Constitution of Dyes (4)</p> <p>2.1.1 Absorption of visible light, Color of wavelength absorbed, Complementary color.</p> <p>2.1.2 Relation between color and chemical constitution. Armstrong theory (quinonoid theory) and its limitations. Witt's Theory: Chromophore, Auxochrome, Bathochromic & Hypsochromic Shift, Hypochromic & Hyperchromic effect Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes: Benzene, Nitrobenzene, Nitroanilines, Nitrophenols, Benzoquinones, Azo, Triphenyl methane, Anthraquinones. Molecular Orbital Theory.</p> <p>2.2..Unit process and Dye Intermediates (11)</p> <p>2.2.1. A brief idea of Unit Processes Introduction to primaries and intermediates, Unit processes: definition and brief ideas of below unit processes: (a) Nitration, (b) Sulphonation, (c) Halogenation, d) Diazotization: (3 different methods & its importance), (e) Ammonolysis, (f) Oxidation</p> <p>2.2.2. Preparation of the Following Intermediates <u>Benzene derivatives</u>: Benzenesulphonic acid; 1,3-Benzenedisulphonic acid; sulphanilic acid; o-, m-, p-chloronitrobenzenes; o-, m-, p-nitroanilines; o-, m-,</p>	

	<p>p-phenylene diamines; Naphthol ASG</p> <p>2.2.3.Naphthalene Derivative; Schaeffer acid; Tobias acid; Naphthionic acid; N.W. acid; cleve-6-acid; H-acid; Naphthol AS, <u>Anthracene Derivative</u>: 1-Nitroanthraquinone; 1-Aminoanthraquinone Anthraquinone-2-sulphonic acid; Benzanthrone.</p>	
	<p>3.1. Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes</p> <p>Nitro Dye: Naphthol Yellow S, Nitroso Dye: Gambine Y</p> <p>Azo dyes: Monoazo dyes: Orange IV *(from sulphanilic acid) & Eriochrome Black T* (from β- naphthol), Bisazo dyes: Congo Red* (from nitrobenzene), Trisazo Dye: Direct Deep Black EW* (from benzidine)</p> <p>Diphenylmethane dye: Auramine O* (from N,N-dimethyl aniline), Triphenylmethane dye:Diamine series: Malachite Green* (from benzaldehyde), Triamine series: Acid Magenta, Phenol series: Rosolic acid</p> <p>Heterocyclic Dyes:Thiazine dyes: Methylene Blue, Azine dyes: Safranin T* (from o-toluidine),Xanthene Dyes: Eosin* (from phthalic anhydride),Oxazine Dyes: Capri Blue,Acridine Dyes: Acriflavine</p> <p>Quinone Dyes:Naphthaquinone: Naphthazarin,Anthraquinone Dyes: Indanthrene Blue* (from anthraquinone),Indigoid Dyes: Indigo* (from aniline + monochloroacetic acid),Phthalocyanine Dyes: Monastral Fast Blue B</p> <p>3.2 Health and Environmental Hazards of Synthetic Dyes and their Remediation Processes</p> <p>3.2.1 Impact of the textile and leather dye Industry on the environment with special emphasis on water pollution</p> <p>3.2.2 Health Hazards: Toxicity of dyes w.r.t food colours.</p> <p>3.2.3 Effluent Treatment Strategies: Brief introduction to effluent treatment plants (ETP), Primary Remediation processes:(Physical Processes) Sedimentation, Aeration, Sorption (activated charcoal, fly ashetc.) Secondary Remediation processes: Biological Remediation, Biosorption, bioremediation and biodegradation. Chemical Remediation: Oxidation Processes (chlorination), Coagulation-flocculation-Precipitation</p>	
	<p>4.1 Non-textile uses of dyes (8)</p> <p>4.1.1 Biomedical uses of dyes: Dyes used in formulations (Tablets, capsules, syrups etc), Indigo carmine, Sunset yellow, Tartrazine, Biological staining agents, Methylene blue, Crystal violet and Safranine T, DNA markers, Bromophenol blue, Orange G, Cresol red, Dyes as therapeutics, Mercurochrome, Acriflavine, Crystal Violet, Prontosil</p> <p>Dyes used in food and cosmetics: Properties of dyes used in food and cosmetics, Introduction to FDA and FSSAI Commonly used food colours and their limits</p> <p>4.1.3 Paper and leather dyes</p> <p>Structural features of paper and leather; Dyes applicable to paper and leather</p> <p>Miscellaneous dyes: Hair dyes, Laser dyes, Indicators, Security inks, Coloured smokes and camouflage colours</p>	

	<p>4.2 Pigments Definition of pigments, examples, properties of pigments, difference between dyes and pigments. Definition of Lakes and Toners</p> <p>4.3 Dyestuff Industry - Indian Perspective 4.3.1 Growth and development of the Indian Dyestuff Industry 4.3.2 Strengths, Weaknesses, Opportunities and Challenges of the Dyestuff industry in India 4.3.3 Make in India - Future Prospects of the Dye Industry</p>	
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References :

1. Chemistry of Synthetic Dyes, Vol I - VIII, Venkatraman K., Academic Press 1972
2. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995
3. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973

T.Y.B.Sc Chemistry (Semester - V)

UGCHDSEP 501: PHYSICAL CHEMISTRY PRACTICAL

Credits: 2

UGCHPP 501	Physical Chemistry Practical	<ol style="list-style-type: none"> 1. To identify the order of reaction between $K_2S_2O_8$ and KI by fractional change method^[4] 2. To illustrate the adsorption of acid on activated charcoal and test the validity of Freundlich adsorption isotherm^[4] 3. To distinguish the solubility product and solubility of a salt potentiometrically using chemical cell.^[2] 4. To evaluate the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.^[4] 5. To organize acidic and basic dissociation constants of an acid and hence to calculate isoelectric point.^[5] 6. To investigate the molecular weight of compound by Rast Method.^[5]
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❖ Non-Instrumental

Colligative properties

To determine the molecular weight of compound by Rast Method

Chemical Kinetics

To determine the order between $K_2S_2O_8$ and KI by fractional change method. (six units and three units)

Surface phenomena

To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.

❖ Instrumental

Potentiometry

To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.

Conductometry

To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.

pH-metry

To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point.

REFERENCES

1. Practical Physical Chemistry 3rd edition A.M. James and F.E. Prichard, Longman publication
2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B. Yadav, Goel Publishing House
4. Advanced Experimental Chemistry. Vol-I b J.N. Gurtu and R Kapoor, S. Chand and Co.
5. Experimental Physical Chemistry by V.D. Athawale.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co. 2011

T.Y.B.Sc Chemistry (Semester - V)

UGCHDSEP 502: INORGANIC CHEMISTRY PRACTICAL

Credits: 2

UGCHPI 502	Inorganic Chemistry Practical	1. To carry out different inorganic complex preparations involving basic skills. ^[3] 2. To determine the of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion. ^[4]
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I. Inorganic preparations

1. Preparation of Potassium diaquobis- (oxalato)cuprate (II)
2. Preparation of Ferrous ethylene diammonium sulphate.
3. Preparation of bisacetylacetonatocopper(II)
4. Bis-8 hydroxy quinolato magnesium(II)
5. Trans Bis(Glycinato) Cu(II)

II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests).

(Any **five salts** of transition metal ions)

REFERENCES

1. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.

T.Y.B.Sc Chemistry (Semester - V) UGCHDSEP 503: ORGANIC CHEMISTRY PRACTICAL

Credits: 2

UGCHDSEP 503	Organic Chemistry Practica 1	<ol style="list-style-type: none"> 1. To carry out separation of binary solid-solid mixture^[4] 2. To able to analyse separated binary mixture. ^[4]
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Separation of Binary solid-solid mixture (2.0 gms mixture to be given).

1. Minimum Six mixtures to be completed by the students.
2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble bases (nitroanilines), water soluble neutral (thiourea) and water insoluble neutral compounds (anilides, amides, m-DNB, hydrocarbons)

After correct determination of chemical type, the separating reagent should be decided by the student for separation.

3. Follow separation scheme with the bulk sample of binary mixture.
4. After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with melting point

REFERENCES

1. Practical organic chemistry - A. I. Vogel
2. Practical organic chemistry - H.Middleton.
3. Practical organic chemistry - O.P.Aggarwal.

T.Y.B.Sc Chemistry (Semester - V) UGCHSECP 504A: ANALYTICAL CHEMISTRY PRACTICAL

Credits: 2

Lectures: 60

UGCHPA 504	Analytical Chemistry Practical	<ol style="list-style-type: none"> 1. To understand Spectrophotometric estimation of fluoride.^[2] 2. To Estimate of magnesium content in Talcum powder.^[4] 3. To Determination of COD of water sample.^[4] 4. To determine the amount of sulphate in given water sample turbidimetrically.^[4] 5. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.^[4]
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1. Spectrophotometric estimation of fluoride
2. Estimation of magnesium content in Talcum powder by complexometry, using standardized solution of EDTA
3. Determination of COD of water sample.
4. To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve method).
5. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.
6. To determine the amount of sulphate in given water sample turbidimetrically.

Note: Calculation of percent error is expected for all the

REFERENCES

1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al

T.Y.B.Sc Chemistry (Semester - V)

UGCHSECP 504B: CHEMISTRY OF DYES PRACTICAL

Credits: 1

UGCHPD 505	Drugs and Dyes Practical	<ol style="list-style-type: none"> 1. To Estimate Ibuprofen by back titration method.^[4] 2. To Estimate Acid neutralizing capacity of a drug.^[4] 3. To Prepare Aspirin from salicylic acid.^[3] 4. To Separate components of natural pigments by paper chromatography^[3] 5. To prepare dye by various method
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1. Separation of components of natural pigments by paper chromatography (eg: chlorophyll)
2. . Preparation of Dyes (**any three**)
 - a. Phenyazo- β -naphthol

- b. Magneson II
 - c. Chrysoidine
 - d. Methylene Blue
3. Estimation of Dyes by reduction method using Titanu chloride (**any Five**)
- a. Indigo carmine
 - b. Amarnath
 - c. Crystal Voilet
 - d. Eosine
 - e. Methylene Blue
 - f. Malachite Green
4. Estmation of coupling component by Diazonium salt solution (**any Four**)
- a. R-Acid
 - b. B-Naphthol
 - c. Resorcinol
 - d. J-acid
5. Separation of Azo, Basic and Vat dyes by chemical method (Two Mixture)
- Project:**
Preparation of Orange II dye (semi-microscale 1.0gms) and its use for dyeing different fabrics

SEMESTER VI

UGCHDSE 601 Physical Chemistry

UNIT I	<p>1.1 Electrochemistry</p> <p>1.1.1 Activity and Activity Coefficient: Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye- Huckel limiting law (No derivation).</p> <p>1.1.2 Classification of cells: Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations are expected).</p> <p>1.2 Applied Electrochemistry (8)</p> <p>1.2.1 Polarization: concentration polarization and its elimination</p> <p>1.2.2 Decomposition Potential and Overvoltage: Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over -voltage.</p>	7
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UNIT II: POLYMERS		(15)
2.1	Basic terms: macromolecule, monomer, repeat unit, degree of polymerization.	
2.2	Classification of polymers: Classification based on source, structure, thermal response and physical properties.	
2.3	Molar masses of polymers: Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity	
2.4	Method of determining molar masses of polymers: Viscosity method using Ostwald Viscometer (derivation expected)	
2.5	Light Emitting Polymers: Introduction, Characteristics, Method of preparation and applications.	
2.6	Antioxidants and Stabilizers: Antioxidants, Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	
UNIT III:		
3.1	BASICS OF QUANTUM CHEMISTRY	(10)
3.1.1	Classical mechanics: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect.	
3.1.2	Quantum mechanics: Introduction, Planck's theory of quantization, wave particle duality, de -Broglie's equation, Heisenberg's uncertainty principle.	
3.1.3	Progressive and standing waves- Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave function.	
3.1.4	Quantum mechanics: State function and its significance, Concept of operator's definition, addition, subtraction and multiplication of operators, commutative and non - commutative operators, linear operator, Hamiltonian operator, Eigen function and Eigen value.	
3.2	Renewable Energy Resources	(5)
3.2.1	Renewable Energy resources: Introduction	
3.2.2	Solar energy: Solar cells, Photovoltaic effect, Differences between conductors, semiconductors, insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell	
3.2.3	Hydrogen: Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium.	
UNIT IV:		15
4.1	NMR -Nuclear Magnetic Resonance Spectroscopy	(7)

4.1.1 Principle : Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, Relaxation processes in NMR (spin -spin relaxation and spin - lattice relaxation).

4.1.2 Instrumentation: NMR Spectrometer

4.2 Electron Spin Resonance Spectroscopy

(8)

4.2.1 Principle: fundamental equation, g-value –dimensionless constant or electron g-factor, hyperfine splitting.

4.2.2 Instrumentation: ESR spectrometer, ESR spectrum of hydrogen and deuterium.

Note : Numericals and Word Problems are Expected from

REFERENCES

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkata.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa - Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.

	<p>10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.</p> <p>11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.</p> <p>12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.</p> <p>13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011..</p> <p>14. Chemical Kinetics, K. Laidler, Pearson Education India, 1987.</p>	
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UGCHDSE 602 INORGANIC CHEMISTRY

UNIT I: Theories of the metal-ligand bond (I)

(15)

- 1.1 Limitations of Valence Bond Theory.
- 1.2 Crystal Field Theory and effect of crystal field on central metal valence orbitals in various geometries from linear to octahedral (from coordination number 2 to coordination number 6),
- 1.3 Splitting of *d* orbitals in octahedral, square planar and tetrahedral crystal fields,
- 1.4 Distortions from the octahedral geometry: (i) effect of ligand field and (ii) Jahn-Teller distortions.,
- 1.5 Crystal field splitting parameters Δ ; its calculation and factors affecting it in octahedral complexes, Spectrochemical series.
- 1.6 Crystal field stabilization energy (CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations,
- 1.7 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series.,
- 1.8 Limitations of CFT: Evidences for covalence in metal complexes

(i) Intensities of d-d transitions, (ii) ESR spectrum of $[\text{IrCl}_6]^{2-}$ (iii) Nephelauxetic effect,

UNIT II: Theories of the metal-ligand bond (II)

2.1 Molecular orbital Theory for coordination compounds.

(4)

2.1.1 Identification of the central metal orbitals and their symmetry suitable for formation of bonds with ligand orbitals.

2.1.2 Construction of ligand group orbitals.

2.1.3 Construction of π -molecular orbitals for an ML_6 complex.

2.1.4 Effect of π -bonding on complexes.

2.1.5 Examples like $[\text{FeF}_6]^{-4}$, $[\text{Fe}(\text{CN})_6]^{-4}$, $[\text{FeF}_6]^{-3}$, $[\text{Fe}(\text{CN})_6]^{-3}$, $[\text{CoF}_6]^{-3}$,

$[\text{Co}(\text{NH}_3)_6]^{+3}$

2.2 Stability of Metal-Complexes

(4)

2.2.1 Thermodynamic and kinetic perspectives of metal complexes with examples.

2.2.2 Stability constants: stepwise and overall stability constants and their interrelationship.

2.2.3 Factors affecting thermodynamic stability.

2.3 Reactivity of metal complexes.

(4)

2.3.1 Comparison between Inorganic and organic reactions.

2.3.2 Types of reactions in metal complexes.

2.3.3 Inert and labile complexes : correlation between electronic configurations and lability of complexes.

2.3.4 Ligand substitution reactions : Associative and Dissociative mechanisms.

2.3.5 Acid hydrolysis, base hydrolysis and anation reactions.

2.4 Electronic Spectra.

(3)

2.4.1 Origin of electronic spectra

2.4.2 Types of electronic transitions in coordination compounds: intra ligand, Charge transfer and intra-metal transitions.

2.4.3 Selection rules for electronic transitions.

- 2.4.4 Electronic configuration and electronic micro states, Terms and Term symbols for transition metal ions, rules for determination of ground state term.
- 2.4.5 Determination of Terms for p^2 and d^1 electronic configurations.

UNIT III: Organometallic Chemistry

3.1 Organometallic Compounds of main group metal (6)

- 3.1.1 General characteristics of various types of organometallic compounds, viz. ionic, π -bonded and electron deficient compounds.
- 3.1.2 General synthetic methods of organometallic compounds : (i) Oxidative-addition, (ii) Metal-metal exchange (transmetallation), (iii) Carbanion-halide exchange, (iv) Metal-hydrogen exchange (metallation) and (v) Methylene-insertion reactions.
- 3.1.3 Some chemical reactions of organometallic compounds: (i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (v) Complex formation reactions.

3.2 Metallocenes (5)

Introduction, Ferrocene : Synthesis, properties, structure and bonding on the basis of VBT.

3.3 Catalysis (4)

- 3.3.1 Comparison between homogeneous and heterogeneous catalysis
- 3.3.2 Basic steps involved in homogeneous catalysis
- 3.3.3 Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.

UNIT IV: Some Selected Topics

4.1 Metallurgy (7)

- 4.1.1 Types of metallurgies.
- 4.1.2 General steps of metallurgy; Concentration of ore, calcinations, roasting, reduction and refining.
- 4.1.3 Metallurgy of copper: occurrence, physicochemical principles, Extraction of copper from pyrites & refining by electrolysis.

4.2 Chemistry of Group 18

(5)

- 4.2.1 Historical perspectives
- 4.2.2 General characteristics and trends in physical and chemical properties
- 4.2.3 Isolation of noble gases
- 4.2.4 Compounds of Xenon (oxides and fluorides) with respect to preparation and structure (VSEPR)
- 4.2.5 Uses of noble gases

4.3 Introduction to Bioinorganic Chemistry.

(3)

- 4.3.1 Essential and non-essential elements in biological systems.
- 4.3.2 Biological importance of metal ions such as Na^+ , K^+ , $\text{Fe}^{+2}/\text{Fe}^{+3}$ and Cu^{+2} (Role of Na^+ and K^+ w.r.t ion pump)

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UGCHDSE603 ORGANIC CHEMISTRY

UNIT I:

1.1 Stereochemistry II (10 L)

1.1.1 Conformational analysis of medium rings: Eight to ten membered rings and their unusual properties, I-strain, transannular reactions

1.1.2 Stereochemistry of – i) Substitution reactions :S_Ni (reaction of alcohol with thionyl chloride)

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ii) Elimination reactions: E2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane.

iii) Addition reactions to olefins: a) bromination (electrophilic anti addition) b) syn hydroxylation with OsO₄ and KMnO₄ c) epoxidation followed by hydrolysis.

1.2 Amino acids & Proteins (5 L)

1.2.1 α -Amino acids: General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel phthalamide synthesis.

1.2.2 Polypeptides and Proteins: nature of peptide bond. Nomenclature and representation of polypeptides (di- and tri-peptides) with examples Merrifield solid phase polypeptide synthesis. Proteins: general idea of primary, secondary, tertiary & quaternary structure.

Unit II

2.1 Molecular Rearrangements (5 L)

Mechanisms, stereochemistry (if applicable) and applications of the following :

Concerted rearrangements : Hofmann , Curtius rearrangement, Cationic rearrangements :

Dienone-phenol, Wagner-Meerwein rearrangement, Anionic rearrangements : Wittig rearrangement

2.2 Carbohydrates (10 L)

2.2.1 Introduction: classification, reducing and non-reducing sugars, DL notation

2.2.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses) Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons.

2.2.3 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers.

2.2.4 Mutarotation in D-glucose with mechanism

2.2.5 Chain lengthening & shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose)

2.2.6 Reactions of D-glucose and D-fructose: (a) Osazone formation (b) reduction: H₂/Ni, NaBH₄

(c) oxidation: bromine water, HNO₃, HIO₄ (d) acetylation (e) methylation: (d) and (e) with cyclic pyranose forms

Unit III

3.1 Spectroscopy II (10 L)

3.1.1 IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region.

3.1.2 PMR Spectroscopy: Basic theory of PMR, nature of PMR spectrum, chemical shift (δ unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, C \equiv C, C=O and benzene ring). Spin-spin coupling and coupling constant. application of deuterium exchange technique. application of PMR in structure determination.

3.1.3 Spectral characteristics of following classes of organic compounds, including benzene and monosubstituted benzenes, with respect to IR and PMR: (1) alkanes (2) alkenes (3) alkynes (4) haloalkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected). Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass and NMR spectroscopic technique are expected. (Index of hydrogen deficiency should be the first step in solving the problems).

3.2 Nucleic acids: (05L)

Selective hydrolysis of nucleic acids. Sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structure of nucleic acids (DNA and RNA): Base pairing in nucleic acids. Importance of nucleic acids-self duplication, protein synthesis.

Unit IV

4.1 Polymer (8 L)

4.1.1 Introduction: terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosetting plastics

4.1.2 Preparation and uses of

Addition polymers: polyethylene, polypropylene, Teflon, polystyrene, PVC, Uses.

Condensation polymers: polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins.

4.1.3 Stereochemistry of polymers: Tacticity

4.1.4 Additives to polymers: Plasticisers, stabilizers and fillers.

4.1.5 Recyclable polymers: Biodegradable polymers: Classification and uses.

4.1.6 Biomedical use of polymers.

4.2 Catalysts and Reagents (7 L)

Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism). 4.2.1 Catalysts: Catalysts for hydrogenation: a. Raney Nickel b. Pt and PtO₂ (C=C, CN, NO₂, aromatic ring) c. Pd/C : C=C, COCl→CHO (Rosenmund) d. Lindlar catalyst: alkynes d 4.2.2 Reagents: a. LiAlH₄ (reduction of CO, COOR, CN,NO₂) b. NaBH₄ (reduction of CO) c. SeO₂ (Oxidation of CH₂ alpha to CO) d. mCPBA (epoxidation of C=C) e. NBS (allylic and benzylic bromination)

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9. Introduction to Organic chemistry,JohnMcMurry.
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References: Unit III.

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2. Spectroscopy, Pavia, Lampman, Kriz,Vyvyan.
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2. Polymer science – a text book by Ahluwalia and Mishra
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5. Organic chemistry by Carey and Sundberg, Part A & B

UGCHSEC604A Analytical Chemistry**UNIT I: Electro Analytical Techniques****1.1 Polarography (Numerical and word problems are expected)****(11)**

- 1.1.1 Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes
- 1.1.2 Basic principle of polarography H shaped polarographic cell, DME(construction, working, advantages and limitations)
- 1.1.3 DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors. Qualitative aspects of Polarography: Half wave potential $E_{1/2}$, Factors affecting $E_{1/2}$ Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation)
- 1.1.4 Quantification 1) Wave height - Concentration plots (working plots/calibration) 2) Internal standard (pilot ion) method 3) Standard addition method
- 1.1.5 Applications advantages and limitations

1.2 Amperometric Titrations**(4)**

- 1.2.1 Principle, Rotating Platinum Electrode(Construction, advantages and limitations)
- 1.2.2 Titration curves with example
- 1.2.3 Advantages and limitations

UNIT II: Methods of Separation - II**2.1 Gas Chromatography (Numerical and word problems are expected)****(9)**

- 2.1.1 Introduction, Principle, Theory and terms involved

- 2.1.2 Instrumentation: Block diagram and components, types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD
- 2.1.3 Qualitative, Quantitative analysis and applications
- 2.1.4 Comparison between GSC and GLC

2.2 Ion Exchange Chromatography

(6)

- 2.2.1 Introduction, Principle.
- 2.2.2 Types of Ion Exchangers , Ideal properties of resin
- 2.2.3 Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor. Factors affecting separation of ions
- 2.2.4 Ion exchange capacity and its determination for cation and anion exchangers.
- 2.2.5 Applications of Ion Exchange Chromatography with reference to preparation of demineralised water, Separation of amino acids

UNIT III: Food and Cosmetics Analysis

3.1 Introduction to food chemistry

(10)

- 3.1.1 Food processing and preservation: Introduction, need, chemical methods, action of chemicals(Sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control Physical methods (Pasteurization and Irradiation)
- 3.1.2 Determination of boric acid by titrimetry and sodium benzoate by HPLC.
- 3.1.3 Study and analysis of food products and detection of adulterants 1) Milk: Composition & nutrients, types of milk (fat free, organic and lactose milk) Analysis of milk for lactose by Lane Eynon's Method
2) Honey: Composition Analysis of reducing sugars in honey by Coles Ferricyanide method 3) Tea: Composition, types (green tea and mixed tea) Analysis of Tannin by Lowenthal's method 4) Coffee: Constituents and composition, Role of Chicory Analysis of caffeine by Bailey Andrew method

3.2 Cosmetics

(5)

- 3.2.1 Introduction and sensory properties
- 3.2.2 Study of cosmetic products –
1) Face powder: Composition Estimation of calcium and magnesium by complexometric titration

- 2) Lipstick: Constituents Ash analysis for water soluble salts: borates, carbonates and zinc Oxide
- 3) Deodorants and Antiperspirants: Constituents, properties Estimation of zinc by gravimetry

UNIT IV: Thermal Methods and Analytical Method Validation

4.1 Thermal Methods

(12)

- 4.1.1 Introduction to various thermal methods (TGA, DTA and Thermometric titration)
- 4.1.2 Thermogravimetric Analysis(TGA) Instrumentation-block diagram,thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder) Thermogram (TG curve)for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. Factors affecting thermogram-Instrumental factors and Sample characteristics. Applications: Determination of drying and ignition temperature range. Determination of percent composition of binary mixtures (Estimation of Calcium and Magnesium oxalate)
- 4.1.3 Differential Thermal Analysis (DTA): Principle, Instrumentation, and Reference material used Differential thermogram (DTA curve) $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ Applications Comparison between TGA and DTA.
- 4.1.4 Thermometric Titrations - Principle and Instrumentation Thermometric titrations of :
 - 1) HCl v/s NaOH
 - 2) Boric acid v/s NaOH
 - 3) Mixture of Ca^{+2} and Mg^{+2} v/s EDTA
 - 4) Zn^{+2} with Disodium Tartarate.

4.2 Analytical Method Validation

03L

- 4.2.1 Introduction and need for validation of a method
- 4.2.2 Validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness Note: Concept of sensitivity is to be discussed for all techniques and instruments mentioned in the syllabus.

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UGCHSEC604B - Chemistry of Drugs	
<p>UNIT I :General introduction to drugs (8)</p> <p>1.1.1 Definition of a drug, sources of drugs, requirements of an ideal drug, classification of drugs (based on therapeutic action)</p> <p>1.1.2 Nomenclature of drugs: Generic name, Brand name, Systematic name</p> <p>1.1.3 Definition of the following medicinal terms: Pharmacon, Pharmacology, Pharmacophore, Prodrug, Half - life efficiency, LD₅₀, ED₅₀, GI₅₀ Therapeutic Index.</p> <p>1.1.4 Brief idea of the following terms: Receptors, Agonists, Antagonists, Drug-receptor interaction, Drug Potency, Bioavailability, Drug toxicity, Drug addiction, Spurious Drugs, Misbranded Drugs, Adulterated Drugs, Pharmacopoeia.</p> <p>1.2 Routes of Drug Administration and Dosage Forms (3)</p> <p>1.2.1 Oral and Parenteral routes with advantages and disadvantages.</p> <p>1.2.2 Formulations & combination formulation, Different dosage forms (including Patches & Adhesives, emphasis on sustained release formulations and enteric coated tablets).</p> <p>1.3 Pharmacodynamic agents (4)</p> <p>1.3.1 CNS Drugs Classification based on pharmacological actions: CNS Depressants & CNS Stimulants. Concept of sedation and hypnosis, anaesthesia.</p> <ul style="list-style-type: none"> ☒ Phenytoin (Hydantoin) ☒ Trimethadione (Oxazolidinediones) (Synthesis from acetone) ☒ Alprazolam (Benzodiazepines) ☒ Levetiracetam (Pyrrolidines) ☒ Amphetamine (Phenethylamine) (Asymmetric synthesis from 	

phenyl acetic acid)

☐ Chlorpromazine (Phenothiazines)

UNIT II:

2.1. Analgesics, Antipyretics and Anti-inflammatory Drugs. (4)

2.1.1 Analgesics and Antipyretics

- ☐ Morphine (Phenanthrene alkaloids)
- ☐ Tramadol (Cyclohexanols) (Synthesis from salicylic acid)
- ☐ Aspirin (Salicylates)
- ☐ Paracetamol (p-Amino phenols)
- ☐ Ambroxol (Cyclohexanol) (Synthesis from paracetamol)
- ☐ Salbutamol (Phenyl ethyl amines)
- ☐ Oxymetazoline (Imidazolines) Codeine Phosphate (Opiates)

2.1.2 Anti-inflammatory Drugs

Mechanism of inflammation and various inflammatory conditions.

- ☐ Steroids: Prednisolone, Betamethasone
- ☐ Sodium Diclofenac, Aceclofenac (N- Aryl anthranilic acids) (Synthesis from 2,6-dichlorodiphenyl amine)

2.2. Antihistaminic Drugs (2)

- ☐ Diphenhydramine (Ethanol amines)
- ☐ Cetirizine (Piperazine) (Synthesis from 4-Chlorobenzhydryl chloride)
- ☐ Chlorpheniramine maleate (Ethyl amines)
- ☐ Pantoprazole (Benzimidazoles)

2.2.1. Cardiovascular drugs (3)

Classification based on pharmacological action

- ☐ Isosorbide dinitrate (Nitrates)
- ☐ Valsartan (Amino acids) (structure not expected)
- ☐ Atenolol (Aryloxy propanol amines) (Synthesis from 3-Hydroxy phenyl acetamide)
- ☐ Amlodipine (Pyridines)
- ☐ Frusemide / Furosemide (Sulfamoyl benzoic acid)
- ☐ Rosuvastatin (Pyrimidine)

2.4. Antidiabetic Agents (2)

The general idea and types of diabetes; Insulin therapy for Glibenclamide (Sulphonyl ureas), Metformin (Biguanides), Dapagliflozin (Pyranose), Pioglitazone (Thiazolidinediones) (Synthesis from 2-(5-ethylpyridin-2-yl) ethanol)

2.5. Antiparkinsonism Drugs (2)

The idea of Parkinson's disease.

<ul style="list-style-type: none"> ☐ Procyclidine hydrochloride (Pyrrolidines) ☐ Ethopropazine hydrochloride (Phenothiazines) ☐ Levodopa (Amino acids) (Synthesis from Vanillin) <p>2.6 Drugs for Respiratory System (2) The general idea of: Expectorants, Mucolytes, Bronchodilators, Decongestants, Antitussives</p>	
<p>UNIT-III</p> <p>3.1. Drug Discovery, Design and Development (3)</p> <p>1.1.1 Discovery of a Lead compound: Screening, drug metabolism studies and clinical observation, Lipinski's rule of 5</p> <p>1.1.2 Medicinal properties of compounds from Natural Sources: Anti-infective and anticancer properties of Turmeric (Curcumin)</p> <p>1.1.3 Development of drug: The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides).</p> <p>1.1.4 Structure modification to increase potency: Homologation, Chain branching and Extension of the structure.</p> <p>1.1.5 Computer assisted drug design.</p> <p>3.2 Drug Metabolism (2) Introduction, Absorption, Distribution, Bio-transformation, Excretion Different types of chemical transformation of drugs with specific examples.</p> <p>3.3 Chemotherapeutic Agents (5) Study of the following chemotherapeutic agents with respect to their chemical structure, chemical class, therapeutic uses, side effects and introduction to MDR wherever applicable.</p> <p>3.3.1. Antibiotics and antivirals: Definition</p> <ul style="list-style-type: none"> ☐ Amoxicillin (β-lactam antibiotics) ☐ Cefpodoxime (Cephalosporins) ☐ Doxycycline (Tetracyclines) ☐ Levofloxacin (Quinolones) (Synthesis from 2,3,4 - Trifluoro -1-nitrobenzene) ☐ Aciclovir/Acyclovir (Purines) <p>3.3.2. Antimalarials: Types of malaria; Symptoms; Pathological detection during window period (Life cycle of the parasites not to be discussed)</p> <ul style="list-style-type: none"> ☐ Chloroquine (3-Amino quinolones) ☐ Artemether (Benzodioxepins) 	

3.3.3 Anthelmintics and AntiFungal agents (Drugs effective in the treatment of Nematodes and Cestodes Infestations)

- ☐ Diethyl carbamazine (Piperazines)
- ☐ Albendazole(Benzimidazoles) (Synthesis from 2-Nitroaniline)
- ☐ Clotrimazole (Imidazole)
- ☐ Fluconazole (Triazole) (Synthesis from 1- Bromo - 2,4-difluorobenzene)

UNIT IV:

4.1 Antiamoebic Drugs (1)

Types of Amoebiasis - Metronidazole, Ornidazole, Tinidazole (Imidazole)
Synthesis of Metronidazole from glyoxal by Debus-Radziszewski imidazole synthesis route. Following combination therapy to be discussed: Ciprofloxacin- Tinidazole.

4.2. Antitubercular and Antileprotic Drugs (3)

Types of Tuberculosis; Symptoms and diagnosis of Tuberculosis. Types of Leprosy. General idea of Antibiotics used in their treatment.

- ☐ PAS (Amino salicylates)
- ☐ Isoniazide (Hydrazides)
- ☐ Pyrazinamide (Pyrazines)
- ☐ (+) Ethambutol (Aliphatic diamines) (Synthesis from 1-Nitropropane)
- ☐ Dapsone(Sulphonamides)(Synthesis from 4-Chloronitrobenzene)
- ☐ Clofazimine (Phenazines)
- ☐ Bedaquiline (Quinoline)

Following combination therapy to be discussed:

- ☐ Rifampin + Ethambutol + Pyrazinamide
- ☐ Rifampin + Isoniazide + Pyrazinamide

4.3 Anti-Neoplastic Drugs (2)

Idea of malignancy; Causes of cancer. Brief idea of Immuno Stimulants &Immuno depressants

- ☐ Lomoustine (Nitrosoureas)
- ☐ Anastrozole(Triazoles) (Synthesis from 3,5-bis(bromo methyl) toluene)
- ☐ Cisplatin (Chloro Platinum)

<p style="text-align: center;">☒ Vincristine, Vinblastine, Vindesine) (Vinca alkaloids) (structure not expected)</p> <p>4.4 Anti-HIV Drugs (1) Idea of HIV pathogenicity, Symptoms of AIDS. AZT/Zidovudine, Lamivudine, DDI (Purines)</p> <p>4.5 Drug Intermediates: Synthesis and uses (2)</p> <ul style="list-style-type: none"> ☒ 2,3,6-Triamino-6-hydroxypyrimidine from Guanidine ☒ p-[2'-(5-Chloro-2-methoxy benzamido) ethyl]-benzenesulphonamide from Methyl-5-chloro-2-methoxybenzene ☒ 3-(p-Chlorophenyl)-3-hydroxypiperidine from 3-Chloroacetophenone ☒ p-Acetyl amino benzenesulphonyl chloride from Aniline ☒ Epichlorohydrine from propene <p>4.6 Nano particles in Medicinal Chemistry (4) Introduction; Carbon nano particles (structures) and Carbon nano tubes:</p> <ul style="list-style-type: none"> ☒ Functionalization for Pharmaceutical applications ☒ Targeted drug delivery ☒ In vaccine (Foot and mouth disease) ☒ Use in Bio-physical treatment. <p>Gold nano particles in treatment of: Cancer; Parkinsonism; Alzheimer. Silver nano particles: Antimicrobial activity.</p> <p>4.7 Drugs and Environmental Aspects Impact of Pharma-industry on environment,</p> <ul style="list-style-type: none"> ☒ International regulation for human experimentation with reference to: "The Nuremberg Code" and "The Helsinki Declaration". 	
REFERENCES:	
<ol style="list-style-type: none"> 1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins. 2. Text book of organic medicinal & pharmaceutical chemistry. Wilson & Gisovolds, 11th Edition by John H Block, John M Beale Jr. 3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition. 4. Burger's Medicinal Chemistry, Drug Discovery and Development. Abraham and Rotella. Wiley 	

5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7. Principle of medicinal chemistry. Vol 1 &2 S. S. Kadam, K. R. Mahadik, K. G. Bothara
8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitscher, Wiley.

T.Y.B.Sc Chemistry (Semester – VI)

UGCHDSEP 601: PHYSICAL CHEMISTRY PRACTICAL

Credits: 2

UGCHPP 601	Physical Chemistry Practical	<ol style="list-style-type: none"> 1. To explain the interpretation of order of reaction graphically.^[2] 2. To calculate the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.^[2,3] 3. To detect the amount of halides in the mixture by potentiometric titration.^[4] 4. To conclude with the determination of number of electrons in the redox reaction.^[3] 5. To predict the amount of Fe(III) in the complex formation.^[5]
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Non-Instrumental

Chemical Kinetics

To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant.
(No fractional order)

Viscosity

To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.

Instrumental

Potentiometry

To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.

To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and ceric sulphate potentiometrically.

Conductometry

To titrate a mixture of weak acid and strong acid against strong base and estimate the amount of each acid in the mixture conductometrically.

Colorimetry

To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method.

Reference:

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication
2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
4. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
5. Experimental Physical Chemistry By V.D.Athawale.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand

T.Y.B.Sc Chemistry (Semester – VI)

UGCHDSEP 602: INORGANIC CHEMISTRY PRACTICAL

Credits: 2

UGCHPI 602	Inorganic Chemistry Practical	<ol style="list-style-type: none">1. To carry out different inorganic complex preparations involving basic skills.^[2,3]2. To determine the of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion by wet tests.^[3,4]
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I. Inorganic preparations

1. Preparation of Tris(acetylacetonato) iron(III)
2. Green synthesis of bis(dimethylglyoximato) nickel(II) complex using nickel carbonate and sodium salt of dmg .
3. Preparation of potassium trioxalato aluminate (III)

II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests). (Any three salts of main group metal ions)

Reference Books (practicals)

1. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
2. Advanced experiments in Inorganic Chemistry, G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
3. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition

T.Y.B.Sc Chemistry (Semester – VI)

UGCHDSEP 603: ORGANIC CHEMISTRY PRACTICAL

Credits: 2

UGCHP 603	Organic Chemistr y Practical	1. To Separate Binary liquid-liquid and liquid-solid mixtures. ^[4] 2. To carry out by distillation method using microscale technique. ^[4]
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Separation of Binary liquid-liquid and liquid- solid mixture.

1. Minimum **15 mixtures** to be completed by the students.
2. Components of the liq-liq mixture should include volatile liquids like acetone, methylacetate, ethylacetate, isopropylalcohol, ethyl alcohol, EMK and non volatile liquids like chlorobenzene , bromobenzene, aniline, N,N dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.
3. Components of the liq- solid mixture should include volatile liquids like acetone, methylacetate, ethylacetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral.
4. A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture.

5. After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.

6. After separation into component A and component B, the compound to be identified can be decided by examiner.

REFERENCES

1. Practical organic chemistry - A. I. Vogel
2. Practical organic chemistry - H.Middleton.
3. Practical organic chemistry - O.P.Aggarwal.

T.Y.B.Sc Chemistry (Semester – VI)

UGCHSECP 604A: ANALYTICAL CHEMISTRY PRACTICAL

Credits: 2

UGCHP 604	Analytical Chemistr y Practical	<ol style="list-style-type: none">1. To estimate Chromium in water sample spectrophotometrically by using Diphenyl carbazide. ^[4]2. To estimate reducing sugar in honey by Willstatter method. ^[4]3. Estimation of Mg⁺² & Zn⁺² by anion exchange resin using an anion exchange resin. ^[4]4. To estimate acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically, ^[4]5. Determination of phosphoric acid in cola sample pH metrically. ^[4]
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1. Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide.
2. Estimation of reducing sugar in honey by Willstatter method.
3. Estimation o Mg⁺² & Zn⁺² by anion exchange resin.using an anion exchange resin
4. Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.
5. Determination of phosphoric acid in cola sample pH metrically.

Note: Calculation of percent error is expected for all the experiments.

REFERENCES

1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al
3. The chemical analysis of food and food products III edition Morris Jacob
4. The chemical analysis of food by David Pearson and Henry Edward

T.Y.B.Sc Chemistry (Semester – VI) UGCHSECP 604B: Chemistry of Drugs Practical

Credits: 1

UGCHSECP604B	Chemistry of Drugs	<ol style="list-style-type: none">1. To Estimate Ibuprofen by back titration method.^[4]2. To Estimate Acid neutralizing capacity of a drug.^[4]3. To Prepare Aspirin from salicylic acid.^[3]4. To Separate components of natural pigments by paper chromatography^[3]5. To Know monogram of drug
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I] Practicals

1. Estimation of Ibuprofen (back titration method)
2. Estimation of Acid neutralizing capacity of a drug
3. Preparation of Aspirin from salicylic acid.
4. Separation of components of natural pigments by paper chromatography (eg: chlorophyll)
5. Chromatography
 - a. Separation of given mixture by Thin layer Chromatography (**Two Mixture**)
 - b. Separation of given mixture by Paper Chromatography (**Two Mixture**)
 - c. Separation of given mixture by Column Chromatography (**Two Mixture**)
- 6.. Separation of Azo, Basic and Vat dyes by chemical method (**Two Mixture**)

II] Project:

To prepare monogram of Drug.