John Wilson Education Society's

Wilson College (Autonomous)

Chowpatty, Mumbai-400007
RE-ACCREDITED 'A' grade by NAAC
Best College Award, University of Mumbai, 2019-20

Affiliated to the

UNIVERSITY OF MUMBAI

Syllabus for Third Year

Program: T.Y.BSc.

Program Code: WUSCHE (Chemistry)

Choice Based Credit System (CBCS) with effect from Academic year 2024–2025

PROGRAM OUTLINE 2024-2025

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
T.Y.B.Sc.	V	WUSCHE501	Physical Chemistry	3
		WUSCHE502	Inorganic Chemistry	3
		WUSCHE503	Organic Chemistry	3
		WUSCHE504	Analytical Chemistry	3
		WUSCHE505	Applied Component- Heavy & Fine Chemicals	3
		WUSCHE5P1	Physical & Inorganic Chemistry Practical -I	4
		WUSCHE5P2	Organic & Analytical Chemistry Practical -I	4
		WUSCHE5P3	Applied Component- Heavy & Fine Chemicals Practical -I	2
T.Y.B.Sc.	VI	WUSCHE601	Physical Chemistry	3
		WUSCHE602	Inorganic Chemistry	3
		WUSCHE603	Organic Chemistry	3
		WUSCHE604	Analytical Chemistry	3
		WUSCHE605	Applied Component- Heavy & Fine Chemicals	3
		WUSCHE6P1	Physical & Inorganic Chemistry Practical -II	4
		WUSCHE6P2	Organic & Analytical Chemistry Practical -II	4
		WUSCHE6P3	Applied Component- Heavy & Fine Chemicals Practical -II	2

PROGRAMME SPECIFIC OUTCOME (PSOs)

1. Gain knowledge of the advanced concepts in the branch of chemistry, scrutinize and accomplish a solution to problems encountered in the field of research and analysis.

2. Apply the basic knowledge of chemistry to perform various tasks assigned to the learners at the workplace in industry and academia to meet the global standards.

3. Deduce qualitative and quantitative information of chemical compounds using advanced spectroscopic methods which can further be analysed using practical skills inculcated in the learners during the course.

4. Imbibe the attitude as well as aptitude of a scientific approach along with analytical reasoning with respect to the novel techniques actually implemented in the Industry.

5. Use the subject knowledge, communication and ICT skills to become an effective team leader/team member in the interdisciplinary fields.

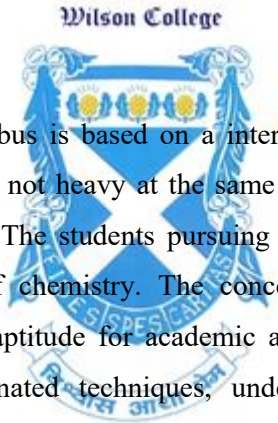
6. Understand, manage and contribute to solve basic societal issues and environmental concerns ethically based on principles of scientific knowledge gained.

7. Exhibit professional work ethics and norms of scientific development.

PREAMBLE

Bachelor of Science (B.Sc.) in Chemistry is an undergraduate course of Department of Chemistry, Wilson College, Chowpatty, Mumbai (Autonomous). The Choice Based Credit System to be implemented through this curriculum would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

This syllabus is prepared to give the sound knowledge and understanding of chemistry to undergraduate students in the third year of the B.Sc. degree course. The goal of the syllabus is to make the study of chemistry as stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make students capable of studying chemistry in academic and industrial courses. Also, to expose the students and to develop interest in them in various fields of chemistry.



The new and updated syllabus is based on a interdisciplinary approach with vigour and depth taking care that the syllabus is not heavy at the same time it is comparable to the syllabi of other universities at the same level. The students pursuing this course would have to develop an understanding of various aspects of chemistry. The conceptual understanding, development of experimental skills, developing the aptitude for academic and professional skills, obtaining basic ideas and understanding of hyphenated techniques, understanding the fundamental chemical processes and rationale towards application of knowledge are among such important aspects.

SEMESTER V

PHYSICAL CHEMISTRY

PROGRAM(s): T.Y.BSc		SEMESTER: V			
Course: Paper-I		Course Code: WUSCHE501			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
4.0	NA	-	3.0	40	60

Learning Objectives:

1. To expose the learner to the basic concepts of surface chemistry and colloidal systems.
2. To understand detection of radioactivity by using different types of counters.
3. To study the principles of nuclear fission and nuclear fusion.
4. To study the origin of rotational, vibrational and Raman spectra.
5. To identify selection rules and relationship between structure and composition of molecules.
6. To study the colligative properties and their methods of determination.
7. To study the reaction rate theories and methods to study fast reactions.

Course Outcomes:

After successful completion of the course, the learner will be able to

1. Collect the fundamental principles on:
   a) Rotational spectroscopy as well as its application in determination of internuclear distance in a molecule.
   b) Vibrational spectroscopy, its application in determination of force constant of a bond as well as the IR spectra of $CO_2$and H_2O.
   c) Raman spectroscopy and comparison between IR & Raman spectra.
   And thus will able to understand spectra and correlate with structure of molecule.
2. Identify the presence of different functional groups, isotopes in the molecule from the spectral data and justify the strength of bonds from the spectral information.
3. Explain the colligative properties of dilute solution and the methods used to determine the same and determine the molecular weight of dissolved solute.
4. Describe the collision theory of reaction rates applied to unimolecular and bimolecular reactions and study the kinetics of fast reactions and to obtain the dependence of reaction rate on reactant concentration on the basis of collision theory
5. Analyze the benefits and drawbacks of osmotic pressure.

Course Code:- WUSCHE501	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**MOLECULAR SPECTROSCOPY**	**15 L**
	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.	3 L
	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.	4 L
	1.3	**Vibrational-Rotational spectrum of diatomic molecule**: energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic 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 H_2O and CO_2 .	4 L
	1.4	**Raman Spectroscopy:** Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stokes lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO_2 molecule.	4 L
	II	**CHEMICAL THERMODYNAMICS & CHEMICAL KINETICS**	**15 L**
		CHEMICAL THERMODYNAMICS	10 L
	2.1	**Colligative properties**: Vapour pressure and relative lowering of vapour pressure. Measurement of lowering of vapour pressure - Static and Dynamic method.	3 L
	2.2	**Solutions of Solid in Liquid**: Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute. Depression in freezing point of a solution, thermodynamic 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.	4 L
	2.3	**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.	3 L

		CHEMICAL KINETICS	5 L
	2.4	Collision theory of reaction rates : Application of collision theory to 1. Unimolecular reaction Lindemann theory and 2. Bimolecular reaction. (derivation expected for both) 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)	5 L
	III	**NUCLEAR CHEMISTRY**	**15 L**
	3.1	**Introduction:** Basic terms-radioactive constants (decay constant, half life and average life) and units of radioactivity	1 L
	3.2	**Detection and Measurement of Radioactivity:** Types and characteristics of nuclear radiations, behaviour of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter.	2 L
	3.3	**Application of use of radioisotopes as Tracers :** Chemical reaction mechanism, age determination - dating by C14	3 L
	3.4	**Nuclear reactions:** nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy.	3 L
	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.	3 L
	3.6	**Fusion Process:** Thermonuclear reactions occurring on stellar bodies and earth.	3 L
	IV	**SURFACE CHEMISTRY**	**15 L**
	4.1	**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.	5 L
	4.2	**Colloidal state**: Introduction to colloids - Emulsions, Gels and Sols. 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.	5 L
	4.3	**Colloidal electrolytes :** Introduction, micelle formation **Surfactants:** Classification and applications of surfactants in detergents and food industry.	5 L

Reference books:-

1. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkata.
2. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
3. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
4. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
5.. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
6. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
7. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.
8. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
9. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
10. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
11. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
12. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011
13. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.
14. Essence of Chemical Kinetics, by Harichandra A. Parbat & Damodar V. Prabhu, Sara Publication, 1st edition, 2022.

INORGANIC CHEMISTRY

PROGRAM(s): T.Y. BSc.	SEMESTER: V				
Course: Paper-II	Course : Inorganic Chemistry Code: WUSCHE502				
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks-40)	Semester End Examination (Marks- 60)
4.0	NA	–	3.0	40	60

Learning Objectives:

1. Students understand and Identify symmetry elements and operations.
2. Students learn with an understanding of the properties, structure, and behaviour of solids at the atomic and molecular level, superconductivity.
3. To provide students with an understanding of the properties, structures, and chemistry of the f-block elements, which include the lanthanides and actinides.
4. Learn chemistry of non-aqueous solvents.
5. To provide students with an understanding of the properties, structures, and chemistry of groups 16 and 17 elements in a periodic table.

Course Outcomes:

On completion of this course Learner will be able to:

1. Evaluate how symmetry influences molecular structure and properties.
2. Develop the knowledge and skills necessary to understand the principles governing the structure and properties of solids
3. Describe the unique properties of inner transition metals and their relationship to electronic structure
4. Analyze the periodic trends and properties of Group 16 and Group 17 elements

Course Code:- WUSCHE502	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**Molecular Symmetry and Chemical Bonding**	**15 L**
	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 the following point groups :(i) $C\infty_V$ (ii) $D\infty_h$ (iii) C_{2V} (iv) C_3v (v) C_2h and (vi) D_3h	6L
	1.2	Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species 1.2.1 Comparison between homonuclear and heteronuclear	9L

		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) H_2O).	
	II	**Solid State Chemistry**	15L
	2.1	**Structures of Solids**	11 L
		2.1.1 Types of Crystalline solids, Explanation of terms viz.crystal lattice, lattice point, unit cell and lattice constants. 2.1.2 Closest packing of rigid spheres one, two and three dimensional, packing density in simple cubic, bcc, fcc and hcp lattices. Relationship between density, radius of unit cell and lattice parameters. (Problems expected) 2.1.3 Voids and its types (triangular, tetrahedral and octahedral) 2.1.4 Stoichiometric Point defects in solids (discussion on Frenkel and Schottky defects expected).	
	2.2	**Superconductivity**	4L
		2.2.1 Discovery of superconductivity 2.2.2 Explanation of terms like superconductivity, transition temperature, Meissner effect. 2.2.3 Different types of superconductors viz.conventional superconductors, alkali metal fullerides, high temperature superconductors. 2.2.4 Brief application of superconductors.	
	III	**Chemistry of Inner Transition Elements**	**15L**
	3.1	Introduction: Position in periodic table and electronic configuration of lanthanides and actinides.	2 L
	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.	6L
	3.3	Occurrence, extraction and separation of lanthanides by (i) Ion Exchange method and (ii) Solvent extraction method (Principles and technique)	6 L
	3.4	Applications of lanthanides	1L

	IV	**Chemistry of Group 16, Group 17 & non-aqueous solvent.**	**15 L**
	4.1	**Chemistry of Non-aqueous Solvents** 4.1.1 Classification of solvents and importance of non-aqueous solvents. 4.1.2 Characteristics and study of liquid ammonia, dinitrogen tetra oxide as non-aqueous solvents with respect to : (i) acid-base reactions and (ii) redox reactions.	5 L
	4.2	**Comparative Chemistry of Group 16** 4.2.1 Electronic configurations, trends in physical properties, allotropy. 4.2.2 Manufacture of sulphuric acid by Contact process.	5 L
	4.3	**Comparative Chemistry of Group 17** 4.3.1 Electronic configuration , General characteristics, anamolous 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) 4.3.2 Chemistry of interhalogens with reference to preparations, properties and structures (on the basis of VSEPR theory) .	5L

Reference books:-

Unit-I

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

ORGANIC CHEMISTRY

PROGRAM(s): T.Y. BSc.	SEMESTER: V				
Course: **Paper-III**	**Course : Organic Chemistry Course Code: WUSCHE503**				
Teaching Scheme					**Evaluation Scheme**
Lectures (per week)	**Practical (per week)**	**Tutorial (per week)**	**Credit**	**Continuous Assessment (CA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
4.0	**NA**	**–**	**3.0**	**40**	**60**

Learning Objectives:

1. To understand and explain the mechanism of pericyclic reactions and its stereochemistry.
2. To understand and illustrate the applications of photochemistry in organic synthesis
3. To study various symmetry elements associated with organic compounds.
4. To know different types of agrochemicals and synthesis of a few of them.
5. To Study advanced heterocycles.
6. To learn IUPAC Nomenclature of Bicyclo, Spiro Compound with multiple functional groups and substituents.
7. To learn the incorporation of green chemistry and safety during synthesis, design of compounds in the laboratory.
8. To learn the importance of natural products and alkaloids in drug discovery, synthetic modifications and retro-approach for structure elucidation.

Course Outcomes:

On completion of this course Learner will be able to

1. Analyze the fundamental concepts of chirality with suitable illustrations.
2. Develop knowledge on agrochemicals as an applied organic chemistry topic with synthesis of certain compounds.
3. Evaluate the principles and complexities of heterocyclic chemistry at an advanced level..
4. Apply the principles of IUPAC nomenclature to identify and name bicyclic systems..
5. Evaluate organic synthesis, progressing from foundational principles to contemporary techniques, incorporating Green synthesis as a reference point.
6. Develop knowledge of spectroscopy and explore UV –Visible and Mass spectroscopic techniques as a tool in structural elucidation of organic compounds.
7. Evaluate the principles of natural products chemistry, focusing on terpenoids and alkaloids.
8. Apply knowledge of organic reaction mechanisms to illustrate pericyclic reactions through relevant examples.
9. Evaluate organic photochemistry through fundamental principles and specific photochemical reactions

Course Code:- WUSCHE503	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**Mechanism of organic reactions & Photochemistry**	**15 L**
		1.1 Mechanism of organic reactions	10 L
		1.1.1 The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity. 1.1.2 Neighbouring group participation in nucleophilic substitution reactions: participation of lone pairs of electrons, kinetics and stereochemical outcome. 1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids (AAC2) and base promoted hydrolysis of esters (BAC2). 1.1.4 Pericyclic reactions, classification and nomenclature 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) 1.1.4.2 Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates	
		1.2 Photochemistry	5 L
		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. 1.2.2 Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4-dienes (di- π methane) 1.2.3 Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol)	
	II	**Stereochemistry I , Agrochemicals & Heterocyclic chemistry**	**15 L**
		2.1 Stereochemistry I	5 L
		2.1.1 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, roation -reflection (alternating) axis. 2.1.2 Chirality of compounds without a stereo genic center: cummulenes and biphenyls.	
		2.2 Agrochemicals	4L

		2.2.1 General introduction & scope, meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators. 2.2.2 Advantages & disadvantages of agrochemicals 2.2.3 Synthesis & application of IAA (Indole Acetic Acid) & Endosulphan, 2.2.4 Bio pesticides – Neem oil & Karanj oil.	
		2.3 Heterocyclic chemistry:	6 L
		2.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quionoline. 2.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler Napieralski synthesis). 2.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with NaNH2/liq.NH3, n-BuLi. 2.3.4 Reactions of quinoline and isoquinoline; oxidation,reduction,nitration,halogenation and reaction with $NaNH_2$/liq.NH_3,n-BuLi.	
	III	**IUPAC & Synthesis of organic compounds**	**15 L**
		3.1 IUPAC	5 L
		IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups): 3.1.1 Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds. 3.1.2 Biphenyls 3.1.3 Cummulenes with upto 3 double bonds 3.1.4 Quinolines and isoquinolines	
		3.2 Synthesis of organic compounds	10 L
		3.2.1 Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, concept of chemoselectivity and regioselectivity with examples, calculation of yields. 3.2.2 Multicomponent Synthesis: Mannich reaction and Biginelli reaction. Synthesis with examples (no mechanism) 3.2.3 Green chemistry and synthesis: Introduction: Twelve principles of green chemistry, concept of atom economy and E-factor, calculations and their significance, numerical examples. i) Green reagents: dimethyl carbonate. ii) Green starting materials : D-glucose	

		iii) Green solvents : supercritical CO2 iv) Green catalysts: Bio catalysts. 3.2.4 Planning of organic synthesis i) synthesis of nitroanilines. (o&p) ii) synthesis of halobenzoic acid.(o&p) iii) Alcohols (primary / secondary / tertiary) using Grignard reagents. iv) Alkanes (using organo lithium compounds)	
	IV	**Spectroscopy I & Natural Products**	**15 L**
		4.1 Spectroscopy I	5 L
		4.1.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency 4.1.2 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. 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.	
		4.2 Natural Products	10 L
		4.2.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule. 4.2.2 Citral: a) Structural determination of citral. b) Synthesis of citral from methyl heptenone c) Isomerism in citral. (cis and trans form). 4.2.3. Alkaloids Introduction and occurrence. Hofmann's exhaustive methylation and degradation in: simple open chain and N – substituted monocyclic amines. 4.2.4 Nicotine: a) Structural determination of nicotine. (Pinner's work included) b) Synthesis of nicotine from nicotinic acid c) Harmful effects of nicotine. 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)	

Reference books:-

Unit I

1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson. 2. Organic chemistry,8th edition, John Mc Murry

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.
7. Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.
8. Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
8. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010.
9. Heterocyclic chemistry, 3rd Edition, Thomas L. Gilchrist, Pearson Education, 2007.

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.
8. Organic chemistry: Francis Carey
9. Organic chemistry: Carey and Sundberg.

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,john vondeling,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.
8. Chemistry of natural products by Chatwal Anand – Vol I and Vol II
9. Chemistry of natural products by O.P. Agarwal
10. Chemistry of natural products by Meenakshi Sivakumar and Sujata Bhat.
11. Organic chemistry by Morrision and Boyd,7th edition.
12. I.L.Finar,Vol-I and Vol-II, 5th edition.

ANALYTICAL CHEMISTRY

PROGRAM(s): T.Y.BSc			SEMESTER: V		
Course: Paper- IV			Course : Analytical Chemistry Course Code: WUSCHE504		
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
4.0	NA	–	3.0	40	60

Learning Objectives:

1. Understand the accurate procedure of sampling & calculating errors involved in measurement.
2. To learn basic principles of redox and complexometric titration. & to learn Basic principle, working and applications of various optical methods like AAS, Flame Photometry, Turbidimetry, Nephelometry, Phosphorimetry, Fluorimetry.
3. To learn the principle and working of solvent extraction, HPLC and HPTLC

Course Outcomes:

1. Develop basic knowledge and understanding of core principles of analytical chemistry.
2. Evaluate the broad applicability of analytical chemistry across different domains to raise awareness among learners.
3. Apply a basic knowledge of redox titration and complexometric titration & separation techniques like solvent extraction, HPLC and HPTLC
4. Recall basic analytical techniques and practical aspects of classical chemical analysis, modern instrumental methods of analysis and separation techniques.
5. Solve problems related to chemical analysis and interpret analytical results.
6. Inculcate research culture in learners.

Course Code:- WUSCHE 504	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**Introduction To Quality Concepts,Chemical Calculations And Sampling**	**15 L**
	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 Quality of material: Various grades of laboratory reagent	3 L
	1.2	**Chemical Calculations (Numerical and word problems are expected)** 1.2.1 Interconversion of Various Concentration Units. (Conversion of concentration from one unit to another unit with examples) 1.2.2 Percent composition of elements in chemical compounds	4 L
	1.3	**Sampling** 1.3.1 Purpose, significance, and difficulties encountered in sampling 1.3.2 Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipment and methods of sampling of compact solids, sampling of particulate solids, methods and equipment used for sampling of particulate solids. 1.3.3 Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids. 1.3.4 Sampling of gases: Ambient and stack sampling: Apparatus and methods for sampling of gases. 1.3.5 Collection, preservation, and dissolution of the sample	8 L
	II	**Classical Methods Of Analysis (Titrimetry)**	**15 L**
	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 diphenylamine and ferroin as redox indicators	8 L
	2.2	**Complexometric Titrations** 2.2.1 Introduction, construction of titration curve 2.2.2 Use of EDTA as titrant and its standardisation, absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity with examples. Advantages and limitations of EDTA as a titrant. 2.2.3 Types of EDTA titrations. 2.2.4 Metallochromic indicators, theory, examples and applications	7 L

	III	**OPTICAL METHODS**	**15 L**
	3.1	**Atomic Spectroscopy: Flame Emission spectroscopy (FES) and Atomic Absorption Spectroscopy(AAS)** 3.1.1 Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra 3.1.2 Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors) 3.1.3 Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser) 3.1.4 Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method. 3.1.5 Comparison between FES and AAS 3.1.6 Applications, Advantages Limit and ions	8 L
	3.2	**Molecular Fluorescence and Phosphorescence Spectroscopy** 3.2.1 Introduction and Principle 3.2.2 Relationship of Fluorescence intensity with concentration 3.2.3 Factors affecting Fluorescence and Phosphorescence 3.2.4 Instrumentation and applications 3.2.5 Comparison of Fluorimetry and Phosphorimetry 3.2.6 Comparison with Absorption methods	4 L
	3.3	**Turbidimetry and Nephelometry** 3.3.1 Introduction and Principle 3.3.2 Factors affecting scattering of Radiation: Concentration, particle size, wavelength, refractive index 3.3.3 Instrumentation and Applications	3 L
	IV	**METHODS OF SEPARATION – I**	**15 L**
	4.1	**Solvent Extraction** 4.1.1 Factors affecting extraction: Chelation, Ion pair formation and Solvation 4.1.2 Graph of percent extraction versus pH. Concept of [pH]1/2 and its significance (derivation not expected) 4.1.3 Craig's counter current extraction: Principle, apparatus and applications 4.1.4 Solid phase extraction: Principle, process and applications with special reference to water and industrial effluent analysis. 4.1.5 Comparison of solid phase extraction and solvent extraction	5 L
	4.2	**High Performance Liquid chromatography (HPLC)** 4.2.1 Introduction and Principle Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating 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) 4.2.2 Qualitative and Quantitative Applications of HPLC	6 L

	4.3	**High Performance Thin Layer Chromatography (HPTLC)** 4.3.1 Introduction and Principle Stationary phase, Sample application and mobile phase 4.3.2 Detectors a) Scanning densitometer- Components. Types of densitometers- Single beam and Double beam b) Fluorometric Detector 4.3.3 Advantages, disadvantages and applications 4.3.4 Comparison of TLC and HPTLC	4 L

Reference books:-

Unit I

1. 3000 solved problems in Chemistry, David E. Goldberg,PhD., Schaums Outline
2. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002)
3. A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001)
4. Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990
5. Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press (2018)
6. Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995

Unit-II

1. Analytical Chemistry Skoog, West ,Holler,7th Edition:

Unit-III

1. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd
2. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman

Unit - IV

1. Analytical Chemistry, Gary.D Christan, 5th edition
2. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication.
3. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited
4. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969
5. Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition
6. High Performance Thin Layer Chromatography by Dr P.D. Sethi, CBS Publisher and Distribution
7. High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer
8. Instrumental methods of Analysis, by Dr Supriya S Mahajan, Popular Prakashan Ltd
9. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman
10. Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969
11. Thin Layer Chromatography, A LAB. Handbook, Egon Stahl, Springer International Student Edition

Applied Component- HEAVY & FINE CHEMICALS

PROGRAM(s): T.Y.BSc		SEMESTER: V			
Course: Paper- V		Course: Applied Component- HEAVY & FINE CHEMICALS , Course Code:WUSCHE505			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
4.0	NA	–	3.0	40	60

Learning Objectives:

1. To familiarise the learner about the applications of chemistry in industries.
2. To introduce the concept and various aspects of starting a small scale industry.
3. To develop the skills required in the area of Industrial Chemistry.
4. To make the learners aware of :
   a) Different chemical manufacturing processes, manufacture of fine and bulk chemicals.
   b) the concept of silicate materials.
5. To understand :
   a) various type of pumps, their construction, working and application
   b)Ppreparation and uses of fertilizers
   c) various types of drugs, their structures, and their modes of action.
6. To familiarise learners about industrial synthesis and usage of solvents.
7. To introduce fluoroaromatics and approaches to assess fluorination.

Course Outcomes:

1. The learners will be equipped with the basic concept, skills and various aspects of chemical industries & will be able to apply the knowledge in working in chemical industries.
2. The learner will demonstrate comprehension of the operations of small-scale industries, enabling them to apply foundational principles in initiating a small-scale industry
3.Learners will evaluate the characteristics of bulk and fine chemicals, including the factors influencing them
4.The learners will be able to evaluate:
   a) The existence of various structures of silicates
   b) The manufacturing processes of bulk chemicals
   c) The various type of pumps, their construction, working and application
   d) The preparation and uses of fertilizers
   e) The importance of fluorination and about Halex reaction.
   f)Identify drugs and will be able to give their scheme of synthesis.
5. Learners will evaluate the criteria defining green solvents and explore innovative eco-friendly alternatives.

Course Code:- WUSCHE505	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**Silicates, Industrial chemicals and manufacturing Processes**	**15 L**
	1.1	**Introduction to Chemical Industry:** Explanation of the terms Heavy (Bulk) and Fine (Speciality) Chemicals	5 L
	1.2	**Silicates:** a) Introduction to silicates:Properties,structure and types of silicates. Preparation of sodium silicate.	5 L
	1.3	**Manufacture and applications of the following: -** a) Talcum powder b) Nitric acid c) Sodium dichromate d) Chromium trioxide	5 L
	II	**Pumps for chemical work and some important fertilizers**	**15 L**
	2.1	**Pumps for chemical work** Introduction of pumps,classification a) centrifugal pump b) positive displacement pump: reciprocating pump, piston pump, diaphragm pump, gear pump, Rotary, vacuum, jet and fluid sealed pump	7 L
	2.2	**Fertilizers**: Preparation, properties and uses of : a) Normal superphosphate b)Triple Superphosphate c) Ammonium nitrate d) Ammonium Sulphate	8 L
	III	**Introduction to Industrial Applications of Chemistry.**	**15 L**
	3.1	Brief idea about the economic aspects of chemical manufacturing processes with respect to Location, Raw materials, Energy, Capital, Manpower, Ecological aspects, Tax benefits. Writing a Project Report for setting up an Industry	9 L
	3.2	**Brief account of perfumes, flavours and sweeteners:** a) **Perfumes**: Introduction, classification (ethers, esters and essential oils) Composition, formation, blending and applications. Synthesis of α and β - ionone‘s from citral . b) **Flavours:** Introduction,Classification (natural and synthetic),applications of Vanillin, Coumarin(structures),Synthesis of Vanillin. c) **Sweeteners**: Introduction, classification with examples and structures of :- A) **Natural sweetners :** Carbohydrates(Glucose, Fructose) B) **Synthetic sweeteners**: i)Sucralose, i)Sulphonamide: eg Saccharin, iii) Peptides: Aspartame, Synthesis of Saccharin .	6 L
	IV	**Drugs, solvents, and fluoroaromatics**	**15 L**

	4.1	**Industrial solvents:-** Manufacture and uses of ethyl acetate ,isopropyl alcohol, Acetone, Acetic acid, Dimethyl formamide, Brief idea of green solvents.	5 L
	4.2	**Introduction to drugs:** Terminology,Classification with one example each. Synthesis and uses of the following :- 1) Ethambutol 2) Mebendazole 3) Benadryl 4) Ibuprofen 5) Miconidazole 6) Diazepam	5 L
	4.3	**Fluoroaromatics:** Introduction, important reagents used for fluorination, Halex reaction, Super Halex reaction, Preparation of ortho-fluorotoluene and 3-chloro-4-fluoro aniline..	5 L

Reference books:-

1. C. D. Dryden: Outlines of Chemical Technology, edited & revised by M. Gopala Rao & Marshall Sittig East West Press, New Delhi.
2. Faith Keyes and Clerk‘s Industrial Chemicals, 4th Edn., Wiley Inter-science 1975.
3. Foust A. S. et-al.: Principles of Unit Operations John Wiley & Sons.
4. Macabe W.L., Smith J. C. and Harriott. P. Unit Operations of Chemical Engineering (7th edition) (McGraw Hill Chemical Engineering series).
5. P. H. Groggins: Unit Processes in Organic Synthesis, McGraw Hill.
6. Kirk & Othmer: Encyclopeadia of Chemical Technology, John Wiley and sons.
7. A. I. Vogel: Text book of Quantitative Analysis including Instrumental Analysis.
8. A. I. Vogel: Text book of Quantitative Organic Analysis.
9. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York.
10. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York.
11. B.Pearson- Speciality Chemical Innovations in Industrial Synthesis.
12. Text Book of Organic Medicinal and Pharmaceutical Chemistry Wilson & Giswold
13. Text Book of Pharmacology – Satoskar & Bhandarkar.
14. The Chemistry of Synthetic Dyes – Edited by K. Venkatraman. Academic press Inc. London.
15. Shreeves _Chemical Process Industries‘ 5th Edition, G. T. Oustin, McGraw Hill.
16. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut.
17. Riegel‘s Hand Book of Industral Chemistry, 9th Edition, Jems A. Kent.
18. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK.
19. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, —‖
20. Unit Operations and Processes- P. H. Groggins.
21. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan.
22. Unit Operations in Chemical Engineering by W. L. McCabe and Smith.
23. Riegel‘s Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi
24. Riegel‘s Handbook of Industrial Chemistry, James A. Kent, 7th Edition, Van Nostrand Reinhold Company.
25. Shreeves _Chemical Process Industries‘ 5th Edition, G. T. Austin, McGraw Hill, 1984.

SEMESTER V

PHYSICAL & INORGANIC CHEMISTRY PRACTICAL-I

PROGRAM(s): T.Y.B.Sc.		SEMESTER: V			
Course: Physical & Inorganic Chemistry Practical -I		Course Code: WUSCHE5P1			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
NA	8 Lectures	–	4.0	40	60

PHYSICAL CHEMISTRY

Learning Objectives:

1. Study rate of reaction, quantitative adsorption,
2. Study potentiometric and pH metric estimation.

Learning outcomes:

1. Learners will be able to determine the order of a reaction by a fractional change method.
2. Learners will be able to estimate how to test the validity of Freundlich adsorption isotherm.
3. Learners will be able to estimate the amount of halides in their mixture as well as to determine the solubility of AgCl potentiometrically.
4. Learners will be able to determine the isoelectric point of an amino acid.

INORGANIC CHEMSITRY

Learning Objectives:

1. Students will learn the synthesis of various complexes of Nickel, copper and Iron
2. Learn the estimation of metal in compounds with volumetric titrations.

Course Outcomes:

1. Analyze the synthesis methods employed in forming complexes of nickel, copper, and iron, discerning the procedural intricacies and chemical reactions involved
2. Learners will be able to estimation of metal in compounds with EDTA titration

Course code	PHYSICAL CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE5P1	**Non-Instrumental:** 1. Colligative properties: To determine the molecular weight of compound by Rast Method 2. Chemical Kinetics: To determine the order between K2S2O8 and KI by fractional change method. (six units and three units)	

	3. Surface phenomena: To investigate the adsorption of acetic acid on activated charcoal and test the validity of isotherms. **Instrumental:** 1. Potentiometry Freundlich adsorption: To determine the solubility product and solubility of AgCl potentiometrically using chemical cells. 2. Conductometry: To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method. 3. pH-metry: To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point.	

Reference books:

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 and Co.. 2011

Course code	INORGANIC CHEMSITRY PRACTICAL	2.0 Credits
WUSCHE5P1	**I. Inorganic preparations** 1. Preparation of Potassium diaquobis- (oxalato)cuprate (II) 2. Preparation of Ferrous ethylene diammonium sulphate. 3. Preparation of bisacetylacetonatocopper(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 three salts of transition metal ions eg Zn, Mg, Fe)	

Reference books:-

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 Semi micro qualitative inorganic analysis. Fifth edition.

ORGANIC & ANALYTICAL CHEMISTRY PRACTICAL-I

PROGRAM(s): T.Y.B.Sc.	SEMESTER: V				
Course: Organic & Analytical Chemistry Practical-I	Course Code: WUSCHE5P2				
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks-40)	Semester End Examination (Marks-60)
NA	8 Lectures	–	4.0	40	60

ORGANIC CHEMISTRY:

Learning Objectives:

1. To impart knowledge to carry out the separation of organic solids from their mixture.

Course Outcomes:

1. Learner will be able to illustrate the separation of solid mixtures of organic compounds using chemical methods.

ANALYTICAL CHEMISTRY:

Learning Objectives:

1. To strengthen the learners knowledge of preparations of solutions of various concentration like Molar, ppm etc.
2. To train the learners to use and handle instruments like spectrophotometer, flame photometer turbidimeter etc and to learn the principle and working of the same.
3. To impart the knowledge about various instrumental and non-instrumental methods for the analysis of commercial samples like Talc, waste water, fertilizers etc.
4. To make students aware of the applications and scope of analytical chemistry in industries.
5. To enhance the skills and employability of the learners.

Course Outcomes:

1. The learners will be able to demonstrate proficiency in using the instruments like spectrophotometer, flame photometer, turbidimeter confidently and understand the principle and their working.
2. The learners will be employed with the procedure and process of analysis of various commercial samples.
3. The learners will be to solve calculations to prepare various solutions required for analysis and also calculate the error in analysis of experimental data.
4. The students will be able to apply their knowledge in applying the knowledge in analysis of industrial samples thereby enhancing their employability or pursuing higher education.

Course code	ORGANIC CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE5P2	1.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) 3. After correct determination of chemical type, the separating reagent should be decided by the student for separation. 4. Follow separation scheme with the bulk sample of binary mixture. 5. After separation into component A and component B, one component (decided by the examiner) is to be analysed and identified with m.p..	

Reference Books :

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

Course code	ANALYTICAL CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE5P2	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	

Reference books:-

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2. Vogel's Textbook of Quantitative Chemical analysis, 6th edition, J.Mendham et.al

Applied Component- Heavy & Fine Chemicals Practical -I

PROGRAM(s): T.Y.B.Sc.	SEMESTER: V				
Course: Applied Component -HEAVY & FINE CHEMICALS Practicals-I	**Course Code: WUSCHE5P3**				
Teaching Scheme					**Evaluation Scheme**
Lectures (per week)	**Practical (per week)**	**Tutorial (per week)**	**Credit**	**Continuous Assessment (CA) (Marks-40)**	**Semester End Examination (Marks- 60)**
NA	**4 Lectures**	_	**2.0**	**40**	**60**

Learning Objectives:

1. To synthesize the desired compound from its precursor.
2. To estimate the amount of active ingredient present in the medicinal drug.

Course Outcomes:

The learner will be able:

1. Demonstrate the synthesis of benzilic acid from benzil through green synthetic route.
2. To show the synthesis of medicinal drug like aspirin.
3. To estimate the amount of iodine present in tincture iodine solution.
4. To determine the amount of acetic acid content in vinegar and methyl salicylate in the supplied sample.

Course code WUSCHE5P3	**Applied Component- Heavy & Fine Chemicals Practical -I**	**2.0 Credits**
	Preparations: (Micro scale) 1. Preparation of Ferrous sulphate heptahydrate 2. Preparation of Aspirin 3. Green synthesis of benzillic acid from benzil. **Estimations** 1) Estimation of tincture iodine. 2) Estimation of methyl salicylate .(Back titration method) 3) Estimation of acetic acid in a sample of vinegar (Titrimetry)	

SEMESTER-VI
PHYSICAL CHEMISTRY

PROGRAM(s): T.Y.BSc		SEMESTER: VI			
Course: Paper-I		Course : Physical Chemistry , Course Code: WUSCHE601			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
4.0	NA	--	3.0	40	60

Learning Objectives:

1. To study the origin, principle (quantitative relationship) and instrumentation of NMR and ESR spectroscopy.

2. To study the significance and future preparedness for availing renewable sources of energy with special emphasis on solar energy.

3. To study electrolytic preparation, storage and safe application of hydrogen gas.

4. To study the laws of quantum mechanics and their implementation in predicting the mechanical parameters.

5. To impart basic concepts of polymer chemistry and light emitting polymers.

6. To understand the application of Nernst equation on different types of concentration cells. To study in detail about applied electrochemistry.

Course Outcomes:

After successful completion of the course, the learner will be able to

1. Describe the principle, instrumentation, working and applications of NMR, ESR & to understand and interpret observed NMR and ESR signals with the chemical and electronic environment nuclei, atoms, molecules and radicals.
2. Evaluate the basics of quantum mechanics and terminologies involved in it, select and apply mathematical functions for tracking the behaviour of quantum systems.
3. Explain the renewable energy sources: solar energy and hydrogen as fuel.
4. Analyze the basic terminologies involved in electrochemistry, study the classification of cells..
5. Analyze the polarization process, decomposition potential and over voltage.
6. Grasp the basic terminologies involved in polymer chemistry, Calculate/determine the molecular weight of a polymer & understand the importance of polymer additives.
7. Explain the principle, construction, working & applications of light emitting polymers.

Course Code:- WUSCHE601	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**ELECTROCHEMISTRY**	**15 L**
	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).	3 L
	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 7L (derivations are expected),	6 L
	1.3	**APPLIED ELECTROCHEMISTRY** Polarization: concentration polarization and it's elimination 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.	6 L
	II	**POLYMERS**	**15 L**
	2.1	Basic terms : macromolecule, monomer, repeat unit, degree of polymerization.	1 L
	2.2	Classification of polymers: Classification based on source, structure, thermal response and physical properties.	2 L
	2.3	Molar masses of polymers: Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity	3 L
	2.4	Method of determining molar masses of polymers : Viscosity method using Ostwald Viscometer. (derivation expected)	3 L
	2.5	Light Emitting Polymers : Introduction, Characteristics, Method of preparation and applications.	3 L
	2.6	Antioxidants and Stabilizers : Antioxidants , Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	3 L
	III	**BASICS OF QUANTUM CHEMISTRY & RENEWABLE ENERGY RESOURCES**	**15 L**
	3.1	**BASICS OF QUANTUM CHEMISTRY**	10 L
	3.1.1	Classical mechanics: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect.	2 L
	3.1. 2	Quantum mechanics : Introduction, Planck's theory of quantization, wave particle duality, de –Broglie's equation, Heisenberg's uncertainty principle	2 L

	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 L
	3.1.4	**Quantum mechanics** : State function and its significance, Concept of operators - definition, addition, subtraction and multiplication of operators, commutative and non - commutative operators, linear operator, Hamiltonian operator, Eigen function and Eigen value.	3 L
	3.2	**RENEWABLE ENERGY RESOURCES**	5 L
	3.2	Renewable energy resources : Introduction. Solar energy: Solar cells, Photovoltaic effect, Differences between conductors,semiconductors ,insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell hydrogen : Fuel of the future, production of hydrogen by direct electrolysis of	5 L
	IV	**NUCLEAR MAGNETIC RESONANCE & ELECTRON SPIN RESONANCE SPECTROSCOPY**	**15 L**
	4.1	**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY (NMR)**	8 L
	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).	5 L
	4.1.2	**Instrumentation & Applications:** NMR Spectrometer	3 L
	4. 2	**ELECTRON SPIN RESONANCE SPECTROSCOPY (ESR)**	7 L
	4.2.1.	Principle: fundamental equation, g-value -dimensionless constant or electron g-factor, hyperfine splitting.	3 L
	4.2.2.	Instrumentation: ESR spectrometer, ESR spectrum of hydrogen and deuterium.	4 L

Reference books:-

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. 7L 8L
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 University 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, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011.
14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.

INORGANIC CHEMISTRY

PROGRAM(s): T.Y. BSc.		SEMESTER: VI			
Course: Paper-II		Course: Inorganic Chemistry, Course Code: WUSCHE602			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
4.0	NA	–	3.0	40	60

Learning Objectives:

1. Students will learn the limitations of VBT, Crystal field theory, its various properties with complex compounds, its stability, and the electronic spectra of coordination compounds.
2. to learn about metal ligands bonds with reference to symmetry group bonding structure
3. Students will understand organometallic compounds of main group elements.
4. Applications of OMC as catalysts will be Enlighted with respect to different reactions.
5. General methods involved in metallurgy, metallurgy of copper study in detail.
6. Role of Bio-inorganic in biological systems , with respect to Na, K Fe and Cu ions

Course Outcomes:

On completion of this course Learner will be able to

1. Describe the concept of metal ions and ligands, including the effect of ligands on different geometries around metal ions resulting in crystal field splitting.
2. Recognize numerous properties of complex compounds and comprehend the origin of electronic spectra.
3. Employ the basic concept of organometallic compounds, their role as catalysts, and their preparation, properties, and reactions.
4. Apply knowledge of metallurgical processes to comprehend copper metallurgy.
5. Analyze the importance of bioinorganic ions in biological lifecycles.

Course Code:- WUSCHE 602	Unit	Course/ Unit Title : Inorganic Chemistry Code:- WUSCHE602	04 Credits
	1	**Theories of the metal-ligand bond (I)**	**15 L**
	1.1	Limitations of Valence Bond Theory.	1 L
	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.	2 L
	1.3	Splitting of *d* orbitals in octahedral, square planar and tetrahedral crystal fields.	2 L
	1.4	Distortions from the octahedral geometry : (i) effect of ligand field and (ii) Jahn-Teller distortions.	2 L
	1.5	Crystal field splitting parameters Δ ; its calculation and factors affecting it in octahedral complexes, Spectrochemical series.	2 L
	1.6	Crystal field stabilization energy(CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations.	2 L
	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.	2 L
	1.8	Limitations of CFT : Evidences for covalence in metal complexes (i) intensities of d-d transitions, (ii) ESR spectrum of $[IrCl_6]^{2-}$ (iii) Nephelauxetic effect.	2 L
	II	**Theories of the metal-ligand bond (II)**	**15L**
	2.1	Molecular orbital Theory for coordination compounds.	4L
		2.1.1 Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals.	
		2.1.2 Construction of ligand group orbitals.	
		2.1.3 Construction of σ-molecular orbitals for an ML6 complex.	

		2.1.4 Effect of π-bonding on complexes .	
		2.1.5 Examples like [FeF6]-4, [Fe(CN)6]-4, $[FeF_6]^{-3}$, $[Fe(CN)_6]^{-3}$, $[CoF_6]^{-3}$, $[Co(NH_3)_6]^{+3}$	
	2.2	**Stability of Metal-Complexes**	4L
		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.**	4L
		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.	
	2.4	**Electronic Spectra.**	3L
		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.	

	III	**Organometallic Chemistry**	**15L**
	3.1	Organometallic Compounds of main group metals	5L
		3.1.1 General characteristics of various types of organometallic compounds, viz.ionic, σ-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 (vi) hydrometallation	
		3.1.3 Some chemical reactions of organometallic compounds:(i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions	
	3.2	**Metallocenes**	5L
		Introduction, Ferrocene : Synthesis, properties, reactions, structure and bonding on the basis of VBT.	
	3.3	**Catalysis**	5L
		3.3.1 Comparison between homogeneous and heterogeneous catalysis	
		3.3.2 Basic steps involved in homogeneous catalysis	
		3.3.3 Hydrogenation of alkenes by using Wilkinson's catalyst, Hydroformylation of alkenes by using cobalt catalyst, Heck reaction by using palladium catalyst	
	IV	**Chemistry of Group 18, Metallurgy & Bio-inorganic.**	**15L**
	4,1	**Metallurgy**	7L
		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	**4.2 Chemistry of Group 18**	5L
		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.**	3L
		4.3.1 Essential and non essential elements in biological systems.	
		4.3.2 Biological importance of metal ions such as Na^{+},K^{+},Fe^{+2}/Fe^{+3} and Cu^{+2}(Role of Na^{+} and K^{+} w.r.t ion pump)	

Reference books:

Unit-I:

1. Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House
3. R. Gopalan , V. Ramalingam Concise Coordination Chemistry , Vikas Publishing House;
4. Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House 5. Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole

Unit-II:

1. Ramesh Kapoor and R.S. Chopra, Inorganic Chemistry, R. Chand publishers,
2. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY,
3. Twigg ,Mechanisms of Inorganic and Organometallic Reactions Publisher: Springer
4 R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House 5 M. L. Tobe Inorganic Reaction Mechanisms Publisher Nelson, 1972 \

Unit-III:

1. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition..
2. H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005
3. Purecell, K.F. and Kotz, J.C., Inorganic Chemistry W.B. Saunders Co. 1977.
4. Robert H. Crabtree ,The Organometallic Chemistry of the Transition Metals, Publication by John Wiley & Sons
5. B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press
6. Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International.

Unit-IV

1. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
2. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press

3. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
4. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
5. R.Gopalan, Chemistry for undergraduates. Chapter 18. Principles of Metallurgy.(567-591)
6. Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)
7. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
8. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
9. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
10. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd

ORGANIC CHEMISTRY

PROGRAM(s): T.Y.B.Sc		SEMESTER: VI			
Course: Paper-III		Course : Organic Chemistry, Course Code: WUSCHE603			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
4.0	NA	–	3.0	40	60

Learning Objectives:

1. To analyze the properties of stereoisomers of a compound are different reactions to prepare stereochemically pure compounds.
2. Amino acids classification and synthesis, classification of proteins. To study some selected rearrangement reactions with mechanisms.
3. To study various structural formulae of different carbohydrates.
4. To know different reactions of carbohydrates. ➢ understand and know the concept of IR and NMR spectroscopy apply the concept of IR and NMR spectroscopy for structural elucidation of organic compound
5. Students will have a clear idea about types, synthesis and applications of polymers.
6. Different types of oxidation and reduction catalysts used in organic synthesis.

Course Outcomes:

The learner will be able to

1. Analyze stereochemistry of reactions through selected examples.
2. Evaluate the significance of amino acids, nucleic acids, and proteins by examining their intricate structures, nomenclature, and properties.
3. Examine the intricate mechanistic details underlying molecular rearrangements and selected name reactions.
4. Assess the complexities of carbohydrate chemistry, focusing on mono-saccharides with five and six carbons, including reactions and stereochemical nuances.
5. Describe the principles of IR and NMR spectroscopy and their synergistic role in solving intricate structural determination problems
6. Critically analyze organic synthetic polymers in terms of their methodical preparation, diverse properties, and multifaceted applications.
7. Evaluate the diverse array of catalysts and reagents employed in organic synthesis and discern their roles in facilitating complex chemical transformations.

Course Code:- WUSCHE 603	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**Stereochemistry II & Amino acids & Proteins**	**15 L**
		1.1 **Stereochemistry II**	10 L
		1.1.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and diastereoselectivity (de), Topicity : enantiotopic and diasterotopic atoms, groups and faces. 1.1.2 Stereochemistry of – i) Substitution reactions: SNi (reaction of alcohol with thionyl chloride) 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 OsO_4 and $KMnO_4$ 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. .Protiens:general idea of primary,secondary,tertiary & quaternary structure	
	II	**Molecular Rearrangements & Carbohydrates**	**15 L**
		2.1 **Molecular Rearrangements**	5 L

		Mechanism of the following rearrangements with examples and stereochemistry wherever applicable. 2.1.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement. 2.1.2 Migration to the electron deficient nitrogen: Beckmann rearrangement. 2.1.3 Migration involving a carbanion : Favorski rearrangement. 2.1.4 Name reactions: Michael addition, Wittig reaction.	
		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. Chair conformation with stereochemistry of D-glucose, Stability of chair form of D-glucose 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: Hi/Ni, NaBH4 (c) oxidation: bromine water, HNO3, HIO4 (d) acetylation (e) methylation:(d) and (e) with cyclic pyranose forms 2.2.7 Glycosides: general structure	
	III	**Spectroscopy II & Nucleic Acids**	**15 L**
		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≡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	5 L
		Controlled hydrolysis of nucleic acids. sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structures of nucleic acids (DNA and RNA) including base pairing.	
	IV	**Polymer & Catalysts and Reagents**	**15 L**
		4.1 Polymer	8 L
		4.1.1 Introduction: terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosets. 4.1.2 Addition polymers: polyethylene, polypropylene, teflon, polystyrene, PVC, Uses. 4.1.3 Condensation polymers: polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins.Uses 4.1.4 Stereochemistry of polymers: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts. 4.1.5 Natural and synthetic rubbers: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer. 4.1.6 Additives to polymers: Plasticisers, stabilizers and fillers. 4.1.7 Biodegradable polymers: Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes. (Note : Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected)	
		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 PtO_2 (C=C, CN, NO_2, aromatic ring) c. Pd/C : C=C, COCl→CHO (Rosenmund) d. Lindlar catalyst: alkynes **4.2.2** Reagents**:** a. $LiAlH_4$ (reduction of CO, COOR, CN,NO_2) b. $NaBH_4$ (reduction of CO) c. SeO_2 (Oxidation of CH_2 alpha to CO) d. mCPBA (epoxidation of C=C) e. NBS (allylic and benzylic bromination)	

Reference books:-

Unit I

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. Biochemistry, 8th Ed., Jeremy Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto Pub. W. H. Freeman Publishers
5. Lehninger Principles of Biochemistry 7th Ed., David Nelson and Michael Cox, Publisher W. H. Freeman
6. Name Reactions – Jie Jack Li, 4th Edition, Springer Pub.

Unit-II

1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
2. Organic chemistry,8th edition, John Mc Murry
3. Organic chemistry (fourth edition),G,Marc Loudon,Oxford University press.
4. Introduction to Organic Chemistry (Third edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmilan publishing.
5. Organic chemistry fourth edition, Morrision and Boyd.
6. Introduction to Organic chemistry, John McMurry.
7. Organic chemistry volume-1&2 (fifth and sixth edition) IL Finar.

Unit-III

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,john vondeling,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.
8. Organic chemistry R.T.Morrison and R.N.Boyd, 6th edition, pearson education 2. S.H.Pine, organic chemistry 4th edition. McGraw Hill

Unit-IV

1. Polymer chemistry by M.G.Arora, K.Singh.
2. Polymer science – a text book by Ahluwalia and Mishra
3. Introduction to polymer chemistry - R.Seymour, Wiley Interscience.
4. Organic chemistry by Francis Carey – McGrawHill .
5. Organic chemistry by Carey and Sundberg, Part A & B

ANALYTICAL CHEMISTRY

PROGRAM(s): T.Y.BSc	SEMESTER: VI				
Course: Paper- IV	**Course: Analytical Chemistry, Course Code: WUSCHE604**				
Teaching Scheme					**Evaluation Scheme**
Lectures (per week)	**Practical (per week)**	**Tutorial (per week)**	**Credit**	**Continuous Assessment (CA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
4.0	**NA**	**–**	**3.0**	**40**	**60**

Learning Objectives:

1. To learn polarographic techniques
2. To impart basic concepts of chromatographic techniques like ion exchange chromatography and Gas Chromatography
3. Study ingredients and methods of analysis of products used our daily needs
4. To impart knowledge of various thermal methods like TGA, DTA, thermometric titration
5. To understand method validation and validation parameters like selectivity, sensitivity etc.

Course Outcomes:

On successful completion of this course students will be able to

1. Analyze the principles and operation of various analytical instruments.
2. Apply techniques for separating chemical mixtures.
3. Evaluate the principles of ion exchange chromatography and gas chromatography.
4. Examine the ingredients and analysis methods of everyday products.
5. Design modern separation or analysis methods for various products.
6. Critique the principles and operation of thermal methods like TGA, DTA, thermometric titration, and validation of analytical methods.

Course Code:- WUSCHE604	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**ELECTRO ANALYTICAL TECHNIQUES**	**15 L**
	1.1	**Polarography (Numerical and word problems are expected)** 1.1.1 Difference between potentiometry and voltammetry, Polarizable and nonpolarizable 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	11 L

		electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors Qualitative aspects of Polarography: Half wave potential E1/2, Factors affecting E1/2 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** 1.2.1 Principle, Rotating Platinum Electrode (Construction, advantages and limitations) 1.2.2 Titration curves with example 1.2.3 Advantages and limitations	4 L
	II	**METHODS OF SEPARATION - II**	**15 L**
	2.1	**Gas Chromatography (Numerical and word problems are expected)** 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	9 L
	2.2	**Ion Exchange Chromatography** 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	6 L
	III	**FOOD AND COSMETICS ANALYSIS**	**15 L**
	3.1	**Introduction to food chemistry** 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	12 L

	3.2	**Cosmetics** 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	3 L
	IV	**THERMAL METHODS AND ANALYTICAL METHOD VALIDATION**	**15 L**
	4.1	**Thermal Methods** 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)forCaC2O4..H2O and CuSO4.5H2O 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) $CaC_2O_4 .H_2O$ and $CuSO_4.5H_2O$ 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	12 L
	4.2	Analytical Method Validation 4.2.1 Introduction and need for validation of a method 4.2.2 Validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness	3 L

Reference books:-

Unit I

1. gyankosh.ac.in/bitstream/123456789/43329/1/Unit-8
2. Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006.
3. Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook ISBN: 978148326478
4. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd

Unit-II

1. Analytical Chemistry, Gary.D Christan, 5th edition
2. Analytical chemistry, R. K. Dave.
3. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969
4. Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition (1992)
5. Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969

Unit-III

1. An Advance Dairy Chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer
2. Analysis of food and Beverages, George Charalanbous, Academic press 1978
3. Food Analysis, Edited by S. Suzanne Nielsen, Springer Unit/s
4. Food Analysis: Theory and practice, Yeshayahu Pomeranz, Clifton E. Meloan, Springer
5. Formulation and Function of cosmetics, Sa Jellineck
6. Government of India publications of food drug cosmetic act and rules.
7. Harry's Cosmetology, Longman scientific co
8. High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributor
9. Modern cosmetics, E. Thomessen Wiley Inter science

Unit - IV

1. Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge
2. Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc
3. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd
4. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman

Applied Component- HEAVY & FINE CHEMICALS

PROGRAM(s): T.Y.BSc	SEMESTER: VI
Course: Paper- V	Course: Applied Component- HEAVY & FINE CHEMICALS Course Code: WUSCHE605

Teaching Scheme					Evaluation Scheme
Lectures (per week)	**Practical (per week)**	**Tutorial (per week)**	**Credit**	**Continuous Assessment (CA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
4.0	**NA**	**–**	**3.0**	**40**	**60**

Learning Objectives:

1. To familiarise the learner about the applications of chemistry in industries. and various aspects of starting a small scale industry.
2. To make the learners aware of different chemical manufacturing processes & to develop the skills required and enhance the employability in the area of Industrial Chemistry.
3. To familiarise the learner with manufacturing process of industrial gases and Inorganic chemicals
4. To understand the concept of composite materials and its applications
5. To make the learners aware of different reactors and vessels used in industries & about industrial unit operations.
6. To let learners understand the basics of dyes, their syntheses, and applications.

Course Outcomes:

On successful completion of this course students will be able to

1. Illustrate foundational concepts, skills, and diverse aspects of chemical industries for application in professional settings.
2. evaluate the functioning of small-scale industries to enhance employability and entrepreneurial opportunities.
3. Analyze composite materials and their practical applications within industrial contexts.
4. Interpret the use of different reactors and vessels in chemical industries.
5. Apply knowledge of manufacturing processes to elucidate the production of fine chemicals and industrial gases.
6. Evaluate industrial unit operations and establish correlations with laboratory methodologies for practical application.
7. Develop comprehensive understanding of dyes and their extensive applications in various industries.

Course Code:- WUSCHE 605	Unit	Course/ Unit Title	04 Credits/ 60 Lectures
	I	**Refrigeration, Different sources of energy and manufacturing of some important chemicals**	**15 L**
	1.1	**Refrigeration:** System, media used for cold transfer (i.e. brine and other)	4 L

	1.2	**Different Sources of Energy:** Generation, Treatment of boiler feed water, Properties of steam, steam table: a)Glass:Composition, types and applications.	5 L
	1.3	**Manufacturing process properties and applications of :** a) Sulphuric acid (Contact Process) b) Ammonia (Haber's process) c) Sodium hydroxide	6 L
	II	**Fine chemicals, Industrial Gases, Components and its applications**	**15 L**
	2.1	.**Zeolites,Clays and Ion-exchange resins**	2 L
	2.2	**Design of vessel :** Classification of chemical reactors, pressure vessels for internal or external pressure, Maintenance, storage vessels for liquids and gases .	3 L
	2.3	**Manufacture and uses of Industrial gases :**Hydrogen and Acetylene	2 L
	2.4	**Industrial preparation of Inorganic Fine chemicals**: KMnO4, FeSO4.7H2O	3 L
	2.5	**Composite materials**:Introduction, Constitution of composites, Classification of composites, Particle Reinforced composites, Fiber reinforced composites, Structural composites or Layered composites, Applications of composite materials.	5 L
	III	**Introduction to Aspects of small scale industries**	**15 L**
	3.1	**Small Scale Industries and R and D technology**:Need and scope of small scale industry, SSI rules and regulations,R and D, technology transfer, Role of R and D, Functional structure of R and D unit, Research strategies and manufacturing interface, University-Industry Interface	9 L
	3.2	**Soaps and Detergents** : Raw materials, Preparation, properties and types of soaps, Continuous process for the manufacture of soap. Introduction,classification and ,industrial applications of detergents	4 L
	3.3	**Oils and Fats:** Introduction, Classification, Properties of oils and fats, extraction of oils from oil seeds, hydraulic pressing and solvent extraction, extraction of animal fats, hardening of oils	2 L
	IV	**Introduction to dyes and industrial operations**	**15 L**
	4.1	**Unit Operations; General idea of the following operations used in Industries;** **1) Filtration:** Introduction, factors affecting the rate of Filtration, Filtration processes a) Plate and frame filter Press b) Rotary Drum filter **2)Distillation:** Introduction, Distillation methods a) Bubble cap column distillation b)Fractional distillation	10 L

		3) Crystallization : Introduction, Solubility, Super saturation, Nucleation, Crystal growth, Crystallization process , a) Agitated Tank Crystallizer, b) Swenson Walker Crystallizer **4) Centrifugation:** Introduction, Centrifugation process used in Industry.	
	4.2	**Introduction to Dyes:** Dye, Chromophores (with examples), Auxochromes (with examples), Synthesis and uses of the following dyes: 1) Indigo 2) Alizarin 3) Eriochrome Black-T 4) Auramine-O 5) Procion-red 6) Congo red	5 L

Reference books:-

1. C. D. Dryden: Outlines of Chemical Technology, edited & revised by M. Gopala Rao & Marshall Sittig East West Press, New Delhi.
2. Faith Keyes and Clerk‘s Industrial Chemicals, 4th Edn., Wiley Inter-science 1975.
3. Foust A. S. et-al.: Principles of Unit Operations John Wiley & Sons.
4. Macabe W.L., Smith J. C. and Harriott. P. Unit Operations of Chemical Engineering (7th edition) (McGraw Hill Chemical Engineering series).
5. P. H. Groggins: Unit Processes in Organic Synthesis, McGraw Hill.
6. Kirk & Othmer: Encyclopeadia of Chemical Technology, John Wiley and sons.
7. A. I. Vogel: Text book of Quantitative Analysis including Instrumental Analysis.
8. A. I. Vogel: Text book of Quantitative Organic Analysis.
9. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York.
10. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York.
11. B.Pearson- Speciality Chemical Innovations in Industrial Synthesis.
12. Text Book of Organic Medicinal and Pharmaceutical Chemistry Wilson & Giswold
13. Text Book of Pharmacology – Satoskar & Bhandarkar.
14. The Chemistry of Synthetic Dyes – Edited by K. Venkatraman. Academic press Inc. London.
15. Shreeves Chemical Process Industries‘ 5th Edition, G. T. Oustin, McGraw Hill.
16. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut.
17. Riegel‘s Hand Book of Industral Chemistry, 9th Edition, Jems A. Kent.
18. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK.
19. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, —‖
20. Unit Operations and Processes- P. H. Groggins.
21. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan.
22. Unit Operations in Chemical Engineering by W. L. McCabe and Smith.
23. Riegel‘s Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi
24. Riegel‘s Handbook of Industrial Chemistry, James A. Kent, 7th Edition, Van Nostrand Reinhold Company.
25. Shreeves _Chemical Process Industries‘ 5th Edition, G. T. Austin, McGraw Hill, 1984.

SEMESTER VI

PHYSICAL & INORGANIC CHEMISTRY PRACTICAL-II

PROGRAM(s): T.Y.B.Sc.		SEMESTER: VI			
Course: Physical & Inorganic Chemistry Practical-II		Course Code: WUSCHE6P1			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutoria (per week)	Credit	Continuous Assessment (CA) (Marks-40)	Semester End Examination (Marks-60)
NA	8 Lectures	-	4.0	40	60

PHYSICAL CHEMISTRY

Learning Objectives:

1. Study the graphical method, viscometric method, colorimetric and conductometric methods for various reactions.

Course Outcomes:

Learner will be able to :

1. Determine the order of a reaction by plotting a graph.
2. Find out the molecular weight of polymer samples by viscometry.
3. Confidently use common lab instruments.

INORGANIC CHEMISTRY

Learning Objectives:

1. Students will learn quantitative techniques involving synthesis and estimation of metal complexes.

Course Outcomes:

Learner will be able to :

1. Analyze the preparation techniques for transition metal complexes.
2. -Apply quantitative estimation methods to analyze metal ion compounds.

Course code	PHYSICAL CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE6P1	**Non-Instrumental:** 1. **Chemical Kinetics**: To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant. (No fractional order) 2. **Viscosity**: To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.	

	Instrumental: **Potentiometry**: 3. To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate. 4. To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and Cerric sulphate potentiometrically. **Conductometry:** 5. 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:** 6. To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method.	

Reference books :

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 and Co.. 2011

Course code	INORGANIC CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE6P1	**I. Inorganic Chemistry Preparation:** 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 :

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.

ORGANIC & ANALYTICAL CHEMISTRY PRACTICAL-II

PROGRAM(s): T.Y.B.Sc.		SEMESTER: VI			
Course: Organic & Analytical Chemistry Practical-II		Course Code: WUSCHE6P2			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
NA	8 Lectures	–	4.0	40	60

ORGANIC CHEMISTRY

Learning Objectives:

1. To train the students to separate the liquid-liquid and solid-liquid mixtures of organic compounds.

Course Outcomes:

1. On successful completion of this course students will be able to get a clear understanding of separation techniques for Liq.- Liq. and Liq.-Solid mixtures using distillation method.

ANALYTICAL CHEMISTRY

Learning Objectives:

1. To train the learners to use and handle instruments like spectrophotometer, conductometer, potentiometer etc and to learn the principle and working of the same.
2. To impart the knowledge about various methods for the analysis of commercial samples like honey, cola vinegar etc..
3. To strengthen the learners knowledge of preparations of solutions of various concentration like Molar, ppm etc.
4. To make students aware of the applications and scope of analytical chemistry.

Course Outcomes:

1. The learners will be able to administer instruments like spectrophotometer, flame photometer, turbidimeter confidently and understand the principle and their working.
2. The learners will be employed with the procedure & process of analysis of commercial samples.
3. The learners will be able to solve calculation to prepare various solutions required for analysis and also calculate the error in analysis of experimental data.
4. The students will be able to apply their knowledge in applying the knowledge in analysis of industrial samples thereby enhancing their employability or pursuing higher education.

Course code	ORGANIC CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE6P2	Separation of Binary liquid-liquid(Volatile and nonvolatile liquid) and (volatile liquid)liquid- solid mixture. 1. Minimum Six 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,ethyl methyl ketone 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 the examiner.	

Reference books:

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

Course code	ANALYTICAL CHEMISTRY PRACTICAL	2.0 Credits
WUSCHE6P2	1. Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide. 2. Estimation of reducing sugar in honey by Willstatter method. 3. Estimation of Mg^{+2} & Zn^{+2} by 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.	

Reference books:-

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

Applied Component- Heavy & Fine Chemicals Practical -II

PROGRAM(s): T.Y.B.Sc.		SEMESTER: VI			
Course: Applied Component- Heavy & Fine Chemicals Practical -II		Course Code: WUSCHE6P3			
Teaching Scheme					Evaluation Scheme
Lectures (per week)	Practical (per week)	Tutorial (per week)	Credit	Continuous Assessment (CA) (Marks-40)	Semester End Examination (Marks-60)
NA	4 Lectures	_	2.0	40	60

Learning Objectives:

1. To synthesize the desired compound from its precursor.
2. To estimate the amount of active ingredient present in the medicinal drug.

Course Outcomes:

Learner will be able to :

1. To synthesize Ni-DMG complex by green synthetic route.
2. To produce copper sulphate pentahydrate and double salt.
3. To determine the active ingredient in samples such as Ibuprofen, milk of magnesia and aspirin.

Course code	Applied Component- Heavy & Fine Chemicals Practical	2.0 Credits
WUSCHE6P3	**Preparation:** 1. Double salt (Ferric alum) 2. Copper sulphate pentahydrate 3. Preparation of Ni-DMG complex **Estimation:** 1. Determination of the amount of. phosphoric acid from a given sample using 1 -naphtholphthalein and phenolphthalein indicator.(Students to prepare succinic acid solution for standardization of NaOH). 2. Determination of the amount of magnesium hydroxide in a commercial sample of milk of magnesia. 3. Estimation of aspirin (Acid-Base titration) 4. Estimation Ibuprofen in the given sample (Back titration method) Industrial visit: Industrial visit report is to be submitted along with the journal.	

Modality of Assessment

Theory Examination Pattern: (A + B = 100 marks)

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	**Written Objective Examination: CIA-I**	**20**
2	**Assignment/ Case study/ field visit report/ presentation/ project, Attendance & Interaction**	**20**
	Total	**40**

B. **External Examination- 60%- 60 Marks per paper**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a. There shall be 05 questions each of 12 marks.
   b. All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1	3 out of 6	12	Unit I
Q.2	3 out of 6	12	Unit II
Q.3	3 out of 6	12	Unit III
Q.4	3 out of 6	12	Unit IV
Q.5	Compulsory	12	Units (I+II+III+ IV)
	TOTAL	**60**	

Practical Examination Pattern:(A +B =50 marks)

A. **Internal Examination: 40%- 20 Marks**

Particulars	Paper I –Paper IV	Applied Component
Journal	05	10
Experimental tasks	15	20 **(Participation in co-curricular & extra curricular activities- 10 mks: Semester V)** **(Industrial visit report- 10 mks : Semester VI)**
Total	**20**	**40**

B. **External Examination: 60%- 30 Marks**

Semester End Practical Examination:

Particulars	**Paper I- Paper IV**	**Applied Component**
Laboratory work	25	50
Viva	05	10
Total	**30**	**60**

PRACTICAL BOOK/JOURNAL

1. **The students are required to perform 75% of the Practical for the journal to be duly certified.**
2. **The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination**