John Wilson Education Society's

Wilson College (Autonomous)

Chowpatty, Mumbai-400007
RE-ACCREDITED 'A' grade by NAAC

Affiliated to the

UNIVERSITY OF MUMBAI

Syllabus for First Year (F.Y.) under
New Education Policy (NEP-2020)
Programme: B.Sc.
Programme Code: WSCHEMJ (Chemistry)

Choice Based Credit System (CBCS) with effect from

Academic year 2023–2024

Programme Outline 2023-2024

YEAR	SEM	COURSE CODE	COURSE NAME	COURSE TITLE	CREDITS
FY.B.Sc.	I	WSCHEMJ111	Discipline specific course (DSC: Mandatory) (Major & Minor) Theory	General Chemistry-I	02 (30L)
		WSCHEMJ112	Discipline specific course (DSC: Mandatory) (Major & Minor) Theory	General Chemistry-II	02 (30L)
		WSCHEMJ113	Discipline specific course (DSC: Mandatory) (Major & Minor) Practical	Chemistry Practical-I	02
		WSCHEOE111	Inter-disciplinary Generic/Open Elective: (OE)	Chemistry in Everyday Life	02 (30L)
		WSCHESE111	Skill Enhancement Course (SEC)	Basic Analytical Chemistry-Practical	02
		WSCHEVE111	Value Education Course (VEC)	Environmental Chemistry	02 (30L)
	II	WSCHEMJ121	Discipline specific course (DSC: Mandatory) (Major & Minor) Theory	General Chemistry-III	02 (30L)
		WSCHEMJ122	Discipline specific course (DSC: Mandatory) (Major & Minor) Theory	General Chemistry-IV	02 (30L)
		WSCHEMJ123	Discipline specific course (DSC: Mandatory) (Major & Minor) Practical	Chemistry Practical-II	02
		WSCHEOE121	Inter-disciplinary Generic/Open Elective: (OE)	Green Chemical Science for Sustainable Future	02 (30L)
		WSCHESE121	Skill Enhancement Course (SEC)	Applied Chemistry- Practical	02
		WSCHEIK121	Indian Knowledge System (IKS)	History and Development of Indian Medicinal Chemistry	02 (30L)

PROGRAMME SPECIFIC OUTCOME (PSOs) FOR B.Sc CHEMISTRY

PSO 1. Apply the basic knowledge of chemistry to perform various tasks assigned at the workplace in industry and academia to meet the global standards.

PSO 2. Undertake research activities and use modern scientific tools to analyze and solve various topics in the research field.

PSO 3. Design system reactions with appropriate considerations in industries and laboratories with respect to safety, economy, health and environment.

PSO 4. Use the subject knowledge, communication and ICT skills to be an effective team leader/team member in the interdisciplinary fields.

PSO 5. Understand, Manage and contribute to solve basic societal issues and environmental concerns ethically based on principles of scientific knowledge gained.

PSO 6. Exhibit professional work ethics and norms of scientific development.

PSO 7. Practice the art of scientific approach and analytical reasoning to become lifelong learners.

PREAMBLE:

Bachelor of Science (B.Sc.) in Chemistry is an undergraduate course of Department of Chemistry, John Wilson Education Society's 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 first 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 disciplinary 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.

Programme(s): F.Y. B. Sc.	SEMESTER: I				
Course: General Chemistry - I	Course Code: WSCHEMJ111				
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examination
2.0	NA	NA	02	Marks- 40	Marks- 60

Learning Objectives:

1. To enable learners to have comprehensive knowledge and understanding of major and basic concepts in chemistry, theoretical principles, etc.
2. To enable learners to develop critical thinking and efficient problem-solving skills in all chemistry disciplines.
3. To develop scientific temper and research-based skills.

Course Outcomes:

1. The learners will be aware of different terms used in thermodynamics and learn the first law of thermodynamics.
2. The learners will be able to prepare solution of different concentration (normality, molality, molarity, formality, mole fraction, ppm, ppb etc)
3. The learner will be able to understand the physical significance of the mathematical statements/expression of the models used for description of the Atomic structure.
4. The learner will be able to give the distribution of the electrons in various shells of an atom by Aufbau's principle and calculate the electronegativity, effective nuclear charge etc.
5. The learners will be able to understand Common and IUPAC nomenclature of different types of organic compounds.
6. The learners will be able to explain the bonding and structure of various organic compounds and various fundamentals of organic reaction mechanisms (electronic effects, cleavage of bonds, structure and stability of organic intermediates) and common types of organic reactions.

DETAILED SYLLABUS

Course Code: WSCHEMJ111	Unit	Course Title-General Chemistry-I	02 Credits/ 30 Lectures
I		**Physical Chemistry**	**10 L**
	1.1	Chemical Thermodynamics: Thermodynamic terms: System, surrounding, boundaries, open, closed and isolated system, intensive and extensive properties, state functions and path functions, zeroth law of thermodynamics First law of thermodynamics: concept of heat (q), work (w), internal energy (U), statement of first law, enthalpy, relation between heat capacities, sign conventions Thermochemistry: Enthalpy of formation of molecules, enthalpy of combustion and Enthalpy of atomization, Kirchhoff's equation (Numericals expected)	(6L)
	1.2	Chemical Calculations:Expressing concentration of solutions: Normality, molality, molarity, formality, mole fractions, ppm, ppb, millimoles, milliequivalents (Numericals expected)	(4L)
II		**Inorganic Chemistry**	**(10 L)**
	2.1	Atomic structure: (Qualitative treatment only; it is expected that the learner knows the mathematical statements and understands their physical significance after completing this topic. No derivations of the mathematical equations required) a) Historical perspectives of the atomic structure; Rutherford's Atomic Model, Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Structure of hydrogen atom. b) Hydrogenic atoms: 1. Simple principles of quantum mechanics; 2. Atomic orbitals i) Hydrogenic energy levels ii) Shells, subshells and orbitals iii) Electron spin iv) Radial shapes of orbitals v) Radial distribution function vi) Angular shapes of orbitals. 3. Many Electron Atoms i) Penetration and shielding ii) Effective nuclear charge (Slater's rule); 3. i) Aufbau principle, ii)Pauli's Exclusion principle, iii) Hund's rule of maximum multiplicity	

III		Basics of Organic Chemistry	(10 L)
	3.1	Classification and Nomenclature of Organic Compounds: Review of basic rules of IUPAC nomenclature. Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines	(03L)
	3.2	Bonding and Structure of organic compounds: Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds, Hybridization: sp, sp^2 and sp^3 hybridization of carbon (ethane, ethene, ethyne) sp and sp^3 hybridization of nitrogen (cyanide and amine); sp^2 and sp^3 hybridizations of oxygen (carbonyl compounds and alcohols) Shapes of molecules (alcohol, ether, aldehyde, ketone, carboxylic acid, ester, cyanide, amine and amide)	(03L)
	3.3	Fundamentals of organic reaction mechanism: Bond fission: Homolytic and Heterolytic fission with suitable examples. Electrophiles and Nucleophiles; Types (primary, secondary, tertiary, allyl, benzyl), shape and their relative stability of reactive intermediates: Carbocations, Carbanions and Free radicals Electronic Effects: Inductive, electromeric, resonance and hyperconjugation effect & their applications	(04L)

References:

Unit I

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).

Unit II

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014. CKT College New Panvel (F.Y.B.Sc, Chemistry Syllabus) 15

4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962. 5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit III

1.Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3.Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.

Programme(s): F.Y.B.Sc.		**SEMESTER: I**			
Course: General Chemistry II		**Course Code: WSCHEMJ112**			
Teaching Scheme					**Evaluation Scheme**
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA)**	**Semester End Examination**
02	**NA**	**NA**	**02**	**Marks- 40**	**Marks- 60**

Learning Objectives:

1. To train the students to get equipped with ICT and digital literacy.
2. To enable learners to have ethical awareness in usage of chemicals, procedures, research and impact on the environment.
3. To develop global competencies , professional skills and leadership qualities

Course Outcomes:

1. Learners will be able to understand the basic aspects of chemical kinetics such as rates, molecularity, rate constants and order of reactions and concepts of surface tension, viscosity and refractive index of liquids thoroughly along with expertise in quantitative analysis from numerical data.

2. Learners will be able to determine the order of reaction from a given data using integration, graphical, Ostwald's isolation and half-time method.

3. Learners will understand the fundamentals of liquid crystal display, classification and its applications, distinguish between metals and nonmetals and to get along with the concepts of catenation, allotropy, diagonal relationship, electronegativity, etc. with periodic trends.

4. By the end of the course, learners will get aware of oxides and oxyacids of N and S with their environmental aspects.
5. They will be introduced to various terms of stereochemistry (stereogenic centre/asymmetric carbon, chirality, etc.) and will learn drawing and interconversion of various projection formulae.

6. Learners will also learn to find out absolute configuration and to distinguish between enantiomers and diastereomers and also the effect of strain on relative stability of conformations and basis of resolution of racemic mixture.

DETAILED SYLLABUS

Course code: WSCHEMJ**112**	**Unit**	**Course/ Unit Title-General Chemistry-II**	**2 Credits /30 Lectures**
I		**Physical Chemistry**	**(10L)**
	1.1	Chemical Kinetics: Rate of reaction, rate constant, measurement of reaction rates, order and molecularity of reaction, integrated rate equation of first and second order reactions (with equal initial concentration of reactants) (Numericals expected) Determination of order of reaction by (a) Integration method (b) Graphical method (c) Ostwald's isolation method (d) Half time method (Numericals expected)	(5L)
	1.2	Liquid State: Surface tension: Introduction, methods of determination of surface tension by drop number method (Numericals expected) Viscosity: Introduction, coefficient of viscosity, relative viscosity, specific viscosity, reduced viscosity, determination of viscosity by Ostwald viscometer (Numericals expected) Refractive index: Introduction, molar refraction and polarizability (numericals expected), Liquid crystals: Introduction, classification and structure of thermotropic phases (Nematic, smectic and cholesteric phases), applications of liquid crystals.	(5L)
II	**2.0**	**Inorganic Chemistry**	**(10L)**
		Comparative chemistry of Main Group Elements: Metallic and non-metallic nature, oxidation states, electronegativity, anomalous behavior of second period elements, allotropy, catenation, diagonal relationship. Comparative chemistry of carbides, nitrides, oxides and hydroxides of group I and group II elements. Some important compounds- $NaHCO_3$, Na_2CO_3, NaCl, NaOH, CaO, $CaCO_3$; oxides of carbon with respect to environmental aspects	

III		**Organic Chemistry**	**(10L)**
	3.1	Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two similar and dissimilar chiral-centres, Diastereoisomers, meso structures, racemic mixture and introduction to resolution methods, Observed and specific rotation (numericals), enantiomeric excess.	(5L)
	3.2	Projections formulae: Fischer Projection, Newman and Sawhorse Projection formulae (of erythro, threo isomers of tartaric acid and 2,3 dichlorobutane) and their interconversions, Geometrical isomerism in alkene and cycloalkanes: cis–trans and syn-anti isomerism E/Z notations with C.I.P. rules, Relative and absolute configuration: D/L and R/S designations. Conformation analysis of alkanes (ethane and n-butane); Relative stability with energy diagrams.	(5L)

References:

Unit I

1.Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2.Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
9. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
10. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
11. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).

Unit II

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. CKT College New Panvel (F.Y.B.Sc, Chemistry Syllabus)
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
6. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit III

1.Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3.Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
6. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition

Programme(s): F.Y.B Sc	SEMESTER: I				
Course: Practical (Paper I & II)	Course Code: WSCHEMJ113				
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examination
NA	4.0	NA	02	Marks- 40	Marks- 60

Learning Objectives:

1. To train the students to get equipped with ICT and digital literacy.
2. To enable learners to develop critical thinking and efficient experimental skills in all chemistry disciplines.
3. To develop scientific temper and research-based skills.

Course Outcomes:

1. Learners will be able to prepare solutions of different concentrations and standardize the given solutions.
2. Learners will be able to determine heat of solution and rate constant of a reaction.
3. Learners will be able to perform quantitative commercial analysis of compounds by volumetric titration method.
4. Learners will be able to calculate the percent purity of samples by gravimetric method.
5. Learners will be able to purify various organic compounds by recrystallization technique and will be able to calibrate the thermometer and determine physical constants such as M.P. and B.P.
6. Learners will be able to perform the technique of thin layer and paper chromatography for separation of components in the mixture.

Course code: WSCHEMJ113	**Course Title- Chemistry Practical-I**	**02 Credit**
	Paper-I	
Unit-I	**Physical Chemistry** 1. To determine the rate constant for the hydrolysis of ester using HCl as catalyst 2. To determine enthalpy of dissolution of salt (like KNO_3) 3.To determine the amount of vitamin C present in given tablet pH metrically 4.Data analysis: Graph plotting and interpretation of data in MS-Excel.	
Unit-II	**Inorganic Chemistry** 1. To prepare 0.1 N succinic acid and standardize the NaOH of two different concentrations 2. Commercial analysis of HCl	
	Paper-II	
Unit-I	**Inorganic Chemistry** 1. Titration using double indicator: analysis of solution of Na_2CO_3 and $NaHCO_3$. 2. Gravimetric analysis i) To determine the percent purity of ZnO containing $ZnCO_3$. ii) To determine percentage purity of sample of $BaSO_4$ containing NH_4Cl	
Unit-II	**Organic Chemistry** 1. To determine the melting and boiling of a given organic compound 2. Purification of any two organic compounds by recrystallization selecting suitable solvent. (Provide 1.0g.). Learners are expected to report a) Solvent for recrystallization. b) Mass and the melting points of purified compounds.	

References:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)
4.Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
5. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. &

Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
6. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
7. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996

Programme(s): F.Y.B.Sc.		**SEMESTER: I**			
Course: Open Elective		**Course Code: WSCHEOE111**			
Teaching Scheme					**Evaluation Scheme**
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA-I)**	**Continuous Assessment (CA-II)**
02	**NA**	**NA**	**02**	**Marks- 30**	**Marks- 30**

Learning Objectives: By the end of the course, students will be able to:

1. Visualize the importance of Chemistry in daily life.
2. Understand the basic principles of chemistry and their relevance to everyday life.
3. Identify the chemical components and processes involved in household products, food, and personal care items.
4. Recognize the impact of chemistry on human health and the environment.
5. Evaluate and make informed choices regarding the use of chemical products in daily life.
6. Demonstrate critical thinking and analytical skills in discussing chemistry-related topics.

Course Outcomes: After studying the course, the student will be able to

1. Analyze the fat content and minerals in milk, butter, and other dairy products.
2. Know about various food preservatives, adulterants, additives, and their analysis.
3. Know about the sources, role, and deficiency symptoms of Vitamins.
4. Learn the importance of renewable energy sources.
5. Recognize the fundamental role of chemistry in everyday activities and applications, such as cooking, cleaning, personal hygiene, and medication

DETAILED SYLLABUS

Course code: WSCHEOE111	**Unit**	**Course Title: Chemistry in Everyday Life**	**2 Credits /30 Lectures**
I		**Chemistry in Kitchen**	**(15L)**
	1.1	**Introduction** to Chemistry in Everyday Life and Overview of topics covered in the course (for e.g cooking utensils, food preparations and storage)	(2L)
	1.2	**Dairy Products:** Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk.	(4L)
	1.3	**Beverages:** Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate, estimation of methyl alcohol in alcoholic beverages.	(3L)
	1.4	**Food additives, adulterants, and contaminants**: Preservatives: Need for preservatives, Classification and types, Natural preservatives. Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Artificial sweetening agents: Classification, types and their effects, Common uses of sweetening agents for examples Aspartame, saccharin, dulcin, sucralose and sodium cyclamate.	(3L)
	1.5	**Carbohydrates and vitamin:** Carbohydrates: Structure, function and Chemistry of some important mono and disaccharides. Vitamins: Classification and Nomenclature. Sources, deficiency diseases and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.	(3L)
II		**Chemistry for our household requirements and medicine**	(15 L)
	2.1	**Cleansing agents:** Chemical composition of Soaps, detergents, dishwashers, drain cleaners, bleaching powder, Toothpaste and shampoo.	(3L)
	2.2	**Stain removers:** Explanation with some common examples.	(2L)
	2.3	**Cosmetics:** Talcum powder, nail polish, thinners, skin care, hair care, Lipsticks, sun protection lotions and creams, eyeshadow and eyebrow pencils, antiperspirants, perfumes and deodorants	(5L)

		explanation with examples.	
	2.4	**Chemicals in medicines:** Introduction and classification of drugs: Analgesics, Tranquilizers, Antiseptics, Disinfectants, Antimicrobials, Antifertility drugs, Antibiotics, Antacids, and Some lifesaving drugs: Epinephrine Hydrochloride (Adrenaline).	(5L)

References:

Unit I

1. B. K. Sharma: introduction to Industiral Chemistry, Goel Publishing, Meerut (1998)
2. The Chemistry of Food; Jan Velisek; Willey Blackwell; 2014
3. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson.
4. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998) 6.

Unit II

1. Drugs and Pharamaceutical Sciences Series, Marcel Dekker, Vol. II, INC, New York
2. Handbook on Feritilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
3. Polymer Science and Technology, J. R. Fired (Prentice Hall).
4. DRUGS A Very Short Introduction; Oxford University Press; 2001
5. Pharmacology: An Introduction to Drugs; Michael C. Gerald; Prentice Hall; 1974

Programme(s): F.Y.B. Sc.	**SEMESTER: I**			
Course: SEC	**Course Code: WSCHESE111**			
Teaching Scheme				**Evaluation Scheme**
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Semester End Examination (Marks- 60)**
NA	**4.0**	**NA**	**02**	**60**

Learning Objectives: The Learners will be able to:

1. Understand and appreciate the nature, role and importance of analytical chemistry
2. To train the students to get equipped with classical and instrumental techniques.
3. To enhance scientific temper and research-based skills.
4. To get hands-on experience in analysis of food adulterants qualitatively.
5. To understand separation technique using Thin layer chromatography.
6. To analyse the analyte present in the sample quantitatively.

Course Outcomes:

Upon completion of the course:

1. The learners will be able to understand the terms and language and appreciate the nature and scope of analytical chemistry.
2. The learners will be able to differentiate between the classical and instrumental methods and will be able to correlate the methods/techniques of analysis and the parameter it measures.
3. Learners will be able to identify all the apparatus and instruments used in chemical analysis
4. Learners will learn various methods to identify the adulterants present in food products qualitatively.
5. The learners will be familiar with the steps involved in Thin layer chromatography.
6. The Learners will gain expertise in volumetric titrations qualitatively as well as quantitatively while handling instruments such as conductometer and pH Meter.

DETAILED SYLLABUS

Course Code: WSCHESE111	**Course Title: Basic Analytical Chemistry-Practical**	**02 Credits**
Paper I	**Analysis of food products:** Nutritional value of foods, idea about food processing and food preservatives and adulteration. **Identification of adulterants** in some common food items like milk, sweets, jaggery, coffee powder, asafoetida, turmeric powder, coriander powder and pulses, etc. (2 experiments)	
	Analysis of water Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. 1. Determination of alkalinity of a water sample. 2. Determination of dissolved oxygen (DO) of a water sample by Wrinkler's method. 3. Determination of sea water Salinity.	
Paper II	**Analysis of soil** Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators 1. Determination of pH of soil samples. 2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	
	Chromatography: Separation of a mixture of o-and p-nitrophenols by thin layer chromatography (TLC)	

	Instrumental Experiments 1. Determination of the amount of HCl present in the given sample Conductometrically. 2. Determination of buffer capacity of acidic buffer by pHmetrically.	

References

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Analytical Chemistry: An Introduction 6th Ed., Saunders College Publishing, Fort Worth, Philadelphia (1994).
4. Harris, D. C. Quantitative Chemical Analysis, 9th ed. Macmillan Education, 2016.
5. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India, 1992.
7. Freifelder, D.M. Physical Biochemistry 2nd Ed., W.H. Freeman & Co., N.Y. USA (1982).
8. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
10. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).
12. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
13. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.
14. Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012.
15. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.

Programme(s): F.Y.B.Sc.	**SEMESTER: I**				
Course: Value Education Course	**Course Code: WSCHEVE111**				
Teaching Scheme					**Evaluation Scheme**
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA-I)**	**Continuous Assessment (CA-II)**
02	**NA**	**NA**	**02**	**(Marks- 30)**	**(Marks- 30)**

Learning Objectives: By the end of the course, students will be able to:

1. Gain the in-depth knowledge and comprehension of numerous local, governmental, and international environmental challenges.
2. Acquire knowledge for environmental management.
3. Visualize the environmental concerns in a critical, imaginative, and evidence-based ways.
4. Gain knowledge about environmental pollution and monitoring techniques.

Course Outcomes: After studying the course, the student will be able to

1. Connect to the multidisciplinary nature of environmental science as a subject after completing the course.
2. Distinguish the relationship among different spheres of the environment
3. Relate the effect of toxins with the effects caused to the environment and human beings.
4. Compare the present-day global environmental issues
5. Practice and teach the community for segregating the waste.
6.. Classify the waste generated from different sources as per their nature.

Course Code: WSCHEVE111	Units	Course Title: Environmental Chemistry	02 Credits/ 30 Lectures
I		**Environmental Structures and concerns**	15 L
	1.1	**Environment's Organisation Definition:** Composition, and structure of the atmosphere, Overview of environmental issues and challenges, Importance of environmental conservation. **Waste as a resource**: Importance of waste as a resource and its potential for recycling and reuse, Sources and types of waste (e.g., municipal, industrial, hazardous), Waste characterization and analysis, Technologies and processes for waste treatment (e.g., recycling, composting, incineration), Landfill design, operation, and environmental impacts, Economic and environmental benefits of recycling **Waste-to-Energy and Conversion Technologies** Energy recovery from waste (e.g., waste-to-energy plants), Anaerobic digestion and biogas production, Conversion of waste into valuable products (e.g., biofuels, biochemicals), Innovative waste management technologies and practices	09 L

	1.2	**Environmental Concerns:** Global warming and the greenhouse effect: sources, effects, and remedies for greenhouse gases. Acid Rain, Brown Haze, Photochemical Smog, Nuclear Winter, Ozone Depletion, Case Studies, World and Indian Scenario	**06 L**
II		**Environmental Toxins**	**15 L**
	2.1	**Environmental Toxins:** Definition of environmental toxins**,** Historical perspectives on environmental toxins**,** Major categories of environmental toxins (chemical, biological, and physical, Routes of exposure **Environmental Fate of Toxins:** bsorption, distribution, metabolism, and excretion (ADME) of toxins**,** Bioaccumulation and biomagnification**,** Environmental persistence and degradation **Human Health Effects of Environmental Toxins:** Acute vs. chronic toxicity**,** Carcinogens, teratogens, mutagens**,** Endocrine-disrupting chemicals (EDCs) Sources and Pathways of Toxins Industrial pollution, Agricultural practices and pesticide use**,** Urban pollutants and air quality issues.	**8 L**
	2.2	**Global Perspectives on Environmental Toxins:** International agreements and conventions**,** Transboundary movement of toxins**,** Emerging challenges and opportunities. **Regulatory Frameworks and Policies:** Overview of environmental regulations**,** Role of governmental and non-governmental agencies**,** Compliance and enforcement challenges **Mitigation and Remediation Strategies**: Best practices for toxin reduction, Environmental impact assessment and remediation, Sustainable and eco-friendly alternatives	**07 L**

References:

1) Environmental Studies by Surana, D. M., Malviya, H. O. SBPD Publishing House.
2) Understanding Earth, New York: Freeman & Company by Grotzinger, J. P., Jordan, T.H.
3) The atmosphere: An introduction to meteorology of Pearson Publications by Luthens, F., Tarbuck
4) Introduction to Environmental Science, New Delhi: TERI by Khoiyangbam, R. S., Navindu, G
5) "Waste-to-Energy: Technologies and Project Implementation" by Marc J. Rogoff, François Screve, and Nicholas J. Themelis.
6) "Solid Waste Technology & Management" by Thomas Christensen, Raffaello Cossu, and David C. Blink.
7) "Recycling: A Guide to the Waste Management Industry" by John G. Hindle
8) "Environmental Chemistry: A Global Perspective" by Gary W. vanLoon and Stephen J. Duffy.
9) "Principles of Environmental Toxicology" by I. Lehrer, T. H. Noseworthy, and C. W. James.
10) "Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes" by Wayne G. Landis, Ruth M. Sofield, and Ming-Ho Yu.
11) "Toxicology: Principles for the Industrial Hygienist" by William A. Burgess.

Programme(s): F.Y. B. Sc.		SEMESTER: II			
Course: General Chemistry III		Course Code: WSCHEMJ121			
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examination
2.0	NA	NA	02	(Marks- 40)	(Marks- 60)

Learning Objectives:

1. Apply the basic knowledge of chemistry to perform various tasks assigned at the workplace in industry and academia to meet the global standards.
2. Undertake research activities and use modern scientific tools to analyse and solve various topics in the research field.
3. Design system reactions with appropriate considerations in industries and laboratories with respect to safety, economy, health and environment.
4. Use the subject knowledge, communication and ICT skills to be an effective team leader/team member in the interdisciplinary fields.

Course Outcomes:

1. The learners will be able to distinguish between real gas and ideal gas along with understanding of different Gas laws and will be able to derive Ideal gas law, understand the reason for deviation of real gas from ideal behavior and understand the Joule Thomson effect.
2. The learners will be able to distinguish between reversible and irreversible reactions, understand Le Chatelier's principle along with understanding the second law of thermodynamics and different terms involved in it.
3. The learner will be able to distinguish between the acids and bases on the basis of the various theories involved and apply the knowledge in understanding the organic reactions and volumetric analysis involving acid base reactions.
4. The learner will be able to perform the qualitative test for the testing of analyte ions and calculate the solubility and solubility product of sparingly soluble salts or weak electrolytes.
5. The learners will be able to understand various preparations and reactions hydrocarbons and to learn selected important name reactions in organic chemistry (oxymercuration-demercuration, hydroboration-oxidation and Diels-Alder reaction).
6. The learners will be able to understand Mechanism of E_1, E_2, E_1cb reactions.

DETAILED SYLLABUS

WSCHEMJ121	Unit	Course Title: General Chemistry III	2 Credits/ 30 Lectures
I		**Physical chemistry**	**(10L)**
	1.1	1.1 Gaseous State: Ideal gas laws, kinetic theory of gases, ideal gases, real gases, compressibility factor, Boyle's temperature (Numericals expected), Deviation from ideal gas laws, reasons for deviation from ideal gas laws, Derivation of Van der Waals equation of state, Joule-Thomson effect: qualitative discussion and experimentation, inversion temperature.	(5L)
	1.2	1.2 Chemical Equilibria and Thermodynamic Parameters: Reversible and irreversible reactions, law of mass action, dynamic equilibria, equilibrium constant, (Kc and Kp), relationship between Kc and Kp, Le Chatelier's principle, factors affecting chemical equilibrium (Numericals expected). Statement of second law of thermodynamics, concepts of entropy and free energy, spontaneity and physical	(5L)

		significance of free energy (Numericals expected)	
II		**Inorganic Chemistry**	**(10L)**
	2.1	Concept of Qualitative Analysis: a) Role of Papers impregnated with Reagents in qualitative analysis (with reference to papers impregnated with starch iodide, potassium dichromate, lead acetate, dimethylglyoxime). b) Precipitation equilibria, effect of common ions, uncommon ions, complexing agents on precipitation of ionic compounds. (Balanced chemical equations and numerical problems expected.)	(5L)
	2.2	Acid Base Theories: Arrhenius, Lowry- Bronsted, Lewis, Solvent – Solute concept of acids and bases, Hard and Soft acids and bases. Applications of HSAB Applications of acid base chemistry in: i) Volumetric analysis with special reference to calculation of titration curve involving strong acid and strong base.	(5L)
III		**Organic Chemistry**	**(10L)**
	3.1	Alkanes: Preparation- Wurtz Reaction, Wurtz-Fittig Reactions, Decarboxylation of carboxylic acids, hydrolysis of grignard reagent Reactions-halogenation of alkane with mechanism	(2L)
	3.2	Alkenes: Preparation-dehydration of alcohols & dehydrohalogenation of alkyl halides elimination reactions: Mechanisms of E_1, E_2, E_1cB reactions. Saytzeff and Hoffmann rule. Reactions- Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), Mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). Introduction to electrocyclic reactions, 1,2-and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction	(6L)
	3.3	Alkynes: Preparation- acetylene from Calcium carbide (applications in fruit ripening); by dehalogenation of tetra-halides & dehydrohalogenation of vicinal dihalides Reactions- Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.	(2L)

References:

Unit I

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).

Unit II

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
3. .Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. CKT College New Panvel (F.Y.B.Sc, Chemistry Syllabus) 15
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
6. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit III

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
6. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013

Programme: F. Y. B. Sc.		SEMESTER: II			
Course: General Chemistry-IV		Course Code: WSCHEMJ122			
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examination
2.0	NA	NA	02	(Marks- 40)	(Marks- 60)

Learning Objectives:

1. To understand, Manage and contribute to solve basic societal issues and environmental concerns ethically based on principles of scientific knowledge gained.
2. To exhibit professional work ethics and norms of scientific development.
3. To practice the art of scientific approach and analytical reasoning to become lifelong learners.

Course Outcomes:

1. Learners will be able to understand the types of buffer solution and will be able to prepare the buffer solution using Henderson's equation.
2. Learners will be able to understand the concept of spectroscopy and different types of interaction such as electronic, vibrational, rotational transitions and phenomena such as absorption, emission, scattering and fluorescence.
3. Learners will be able to understand different types of solids and the terms involved such as crystal lattice, lattice points, unit cell, space lattice, lattice plane and laws of crystallography.
4. Learners will understand the basic concepts under reduction potential such as half reactions, balancing redox reactions and net reaction and to interpret the Latimer and Frost diagrams.
5. Learners will be able to draw and compare the relative stabilities of various conformations of cycloalkanes and cyclohexane (in details).
6. Learners will be able to apply the concepts of aromaticity in finding out nature (aromatic/nonaromatic/antiaromatic) of a given new molecule and their mechanisms for electrophilic aromatic substitution reactions.

DETAILED SYLLABUS

Course code: WSCHEMJ122	Unit	Course Title : General Chemistry IV	02 Credits / 30 Lectures
I		**Physical Chemistry**	**10 L**
	1.1	Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water, ionization of weak acids and bases, pH scale, common ion effect, dissociation constants of mono-, di- and triprotic acid (exact treatment for monoprotic acid); Buffers: Introduction, types of buffers, derivation of Henderson equation for acidic and basic buffers, buffer action, buffer capacity (Numericals expected)	(5L)
	1.2	Molecular Spectroscopy: Electromagnetic radiation, electromagnetic spectrum, Planck's equation, interaction of electromagnetic radiation with matter: Absorption, emission, scattering, fluorescence, electronic, vibrational and rotational transitions, Beer-Lambert's law (Numericals expected)	(2L)
	1.3	Solid State Chemistry Types of solids, crystal lattice, lattice points, unit cell, space lattice and lattice plane, laws of crystallography: Law of constancy of interfacial angle, law of symmetry and law of rational indices (Numericals expected) radius ratio rule and packing in crystals.	(3L)
II		**Inorganic Chemistry**	**10 L**
	2.1	Chemical Bond and Reactivity: Types of chemical bond, comparison between ionic and covalent bonds, polarizability (Fajan's Rule), shapes of molecules, Lewis dot structure, basic VSEPR theory for ABn type molecules with and without lone pair of electrons, applications and limitations of VSEPR theory.	(5 L)
	2.2	Oxidation Reduction Chemistry: a) Reduction potentials b) Redox potentials: half reactions; balancing redox equations. i) Latimer and Frost Diagrams ii) pH dependence of redox potentials. d) Applications of redox chemistry i) Extraction of elements: (example: isolation of copper by auto reduction) ii) Redox reagents in Volumetric analysis: a) I_2 (Iodine); b) $KMnO_4$	(5 L)

III		Organic Chemistry	10 L
	3.1	Stereochemistry-II: Cycloalkanes and Conformational Analysis: Angle strains in cycloalkanes, Types of cycloalkanes, Conformation of cyclobutane, cyclopentane, Conformational Analysis of cyclohexane and their relative stability.	(4L)
	3.2	Aromaticity Aromaticity: Hückel's rule, anti-aromaticity, homo-aromaticity, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples.	(2L)
	3.3	Electrophilic aromatic substitution :halogenation, nitration, sulphonation and Friedel-Craft alkylation/acylation with their mechanism, Directing effects of the groups.	(4L)

References:

Unit I

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013)
3. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
4. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
5. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).

Unit II

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014. CKT College New Panvel (F.Y.B.Sc, Chemistry Syllabus) 15
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962. 5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit III

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
5. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

Programme(s): F.Y.B Sc	SEMESTER:II				
Course: Practical (Paper 1&2)	Course Code: WSCHEMJ123				
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) (Marks- 40)	Semester End Examination (Marks- 60)
NA	4.0	NA	02	40	60

Learning Objectives:

1. Apply the basic knowledge of chemistry to perform various tasks assigned at the workplace in industry and academia to meet the global standards.
2. Get familiarized with the fundamental techniques of the chemical analysis.
3. Design system reactions with appropriate considerations in industries and laboratories with respect to safety, economy, health and environment.

Course Outcomes:

1. Learners will be able to perform kinetic investigation for saponification reactions.
2. Learners will understand principle and working of pH-meter and determine the dissociation constant of any given acid pH-metrically.
3. Learners will understand principle, working and operation of colorimeter and verify Beer-Lambert's law colorimetrically.
4. Learners will be able to perform standardization of the given acid sample and learn safety measures for various chemicals.
5. Learners will be able to analyse cations and anions in a given mixture qualitatively.
6. Learners will be able to understand the principle of redox titration and estimate copper in a given sample quantitatively by iodometric method.
7. Learners will be able to identify an unknown organic compound by analysing its chemical nature, elements, functional group and physical constant.

Course code: WSCHEMJ123	**Chemistry Practical-II**	**02 Credits**
	Paper-I	
Unit-I	**Physical Chemistry** 1. To determine the rate constant for the saponification reaction between ethyl acetate and NaOH 2. To determine dissociation constant of weak acid (Ka) using Henderson's equation and the method of incomplete titration pHmetrically. 3. To verify Beer-Lambert's law, using $KMnO_4$ solution by colorimetric method. 4. To standardize commercial sample of HCl using borax and to write material safety data of the chemicals involved.	
Unit-II	**Inorganic Chemistry** 1. Qualitative analysis: (at least 3 mixtures to be analyzed) Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions. Cations (from amongst): Pb^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+}, Ni^{2+}, Mn^{2+}, Mg^{2+}, Al^{3+}, Cr^{3+}, K^+,NH_4^+ Anions (From amongst): CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-} (Scheme of analysis should avoid use of sulphide ion in any form for precipitation /separation of cations.)	
	Paper-II	
Unit-I	**Inorganic Chemistry** Redox Titration: To determine the percentage of copper(II) present in a given sample by titration against a standard aqueous solution of sodium thiosulfate (iodometry titration)	
Unit-II	**Organic Chemistry** Characterization of organic compounds containing C, H, (O), N, S, X elements. (minimum 5 compounds)	

References

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H.

Freeman and Co., New York (2003).

4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)
5. Practical Inorganic Chemistry by G. Marr and B. W. Rockett van Nostrand Reinhold Company (1972)
6. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
7. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000). Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
8. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
9. Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996
10. Introduction to Semimicro Qualitative Analysis, C. H. Sorum, J. J. Logowski, Prentice-Hall, 5th edition, 1996

Programme: F.Y.B. Sc.	SEMESTER:II				
Course: Open elective: Green Chemical Science for sustainable future	Course Code: WSCHEOE121				
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA-I)	Continuous Assessment (CA-II)
02	NA	NA	02	Marks 30	Marks 30

Learning Objectives: By the end of this course, students will be able to:

1. Define the principles and goals of green chemistry.
2. Understand the environmental challenges associated with traditional chemical processes.
3. Identify and apply green chemistry principles to design sustainable chemical reactions.
4. Evaluate and compare the environmental impact of different chemical processes using life cycle assessment.
5. Analyze the role of catalysts in green chemistry and their application in sustainable reactions.
6. Select appropriate solvents and reaction conditions for green synthesis.
7. Develop strategies for waste minimization and resource efficiency in chemical processes.

Course Outcomes:Upon completion of this course, students will be able to:

1. Explain the key principles and goals of green chemistry and their significance in addressing environmental challenges.
2. Apply green chemistry principles to design and optimize chemical reactions with reduced waste generation and energy consumption.
3. Identify and evaluate the role of catalysts in green chemistry and their application in various reaction types.
4. Select suitable solvents and reaction conditions for green synthesis, considering factors such as toxicity, biodegradability, and renewability.
5. Design strategies for waste minimization, recycling, and resource efficiency in chemical processes and to analyze case studies and real-world examples to understand the practical implementation of green chemistry in industry and research.
6. Green chemistry approaches for developing sustainable materials and technologies.

Course code:WSCHEOE121	Unit	Course Title: Green Chemical Science for sustainable future	02 Credits/ 30Lectures
I		**Principles and Concept of Green Chemistry**	**15 L**
	1.1	Introduction - Green chemistry Need and scope of green Chemistry: Introduction to chemical waste, sources, composition, causes and effect on human life and environment	(4L)
	1.2	Concept of green chemistry, Principles of green chemistry Sustainable Green chemistry. Goal of green chemistry, Limitations / obstacle of green chemistry.	(6L)
	1.3	Global recognition in green chemistry and applications in the field of environment, agricultural, transportation, waste management etc.	(5L)
II		**Green Chemistry for Sustainable development.**	**15L**
	2.1	Introduction to Green Solvents: definition, classification, physical properties Green Solvents: SuperCritical Water, Supercritical Carbon Dioxide (SC-CO_2).	**(3L)**
	2.2	Renewable Resources: Biomass, Renewable energy, Fossil fuels, Energy from biomass, Solar power, Other forms of renewable energy-Fuel-Cells, Syngas economy, Hydrogen economy, Bio-refinery chemicals from fatty acids, Polymer from renewable resources, Some other natural chemical resources.	**(6L)**
	2.3	Importance of Green Chemistry for Human Welfare: Sustainable energy, role of green chemistry and technology in defence of human welfare, industrial ecology, 10 commandments of sustainability.	**(6L)**

References:

Unit I:

1. Green Chemistry in Pharmaceutical Industry, P. J. Dunn. A. Wells, M. T. Williams, Wiley VCH, 2010.
2. Green Chemistry- An Introductory Text; M. Lancester, RSC Publishing, 2nd Edn.; 2010
3. Green Chemistry; Samuel Delvin; IVY Publishing House; Ist Edn.; 2008.
4. Methods and Reagents of Green Chemistry: An Introduction, P. Tundo (Editor), A. Perosa, F. Zecchini, 2007.

Unit II:

1. Green Chemistry- Environment Friendly Alternatives; Rashmi Sangh & M. M Srivastava; Narosa, 2007.
2. Green Chemistry– Environment Benign Reactions, V. K. Ahluwalia, CRC Press, 2007
3. Green Chemistry theory and Practice, P. T. Anastas and J. C. Warner, Oxford University Press, 2000
4. Stream Lined Life-Cycle assessment, T. E. Graedel, Prentice Hall, New Jersey, 1998.
5. A Textbook of Green Chemistry by Sankar Prasad Dey & Nayim Sepay,2021, TECHNO WORLD, ISBN: 978-93-92145-03-2

Programme(s): F.Y.B Sc.	**SEMESTER:II**			
Course: SEC: Applied Chemistry-Practical	**Course Code: WSCHESE121**			
Teaching Scheme				**Evaluation Scheme**
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Semester End Examination**
NA	**4.0**	**NA**	**02**	**60 marks**

Learning Objectives:

1. To train the students to get equipped with synthetic techniques.
2. To train students to understand the difference between organic and green synthesis.
3. To enhance scientific temper and research-based skills.
4. To understand purification techniques.
5. To analyze the analyte present in the sample Quantitatively and Qualitatively.

Course Outcomes: Upon completion of the course:

1. The learners will develop a practical hand in synthesis.
2. The learners will understand the important aspects and safety concerns while dealing with different chemicals.
3. The learners will gain expertise in product purification and measurements of its physical constants.
4. The learners will be able to identify all the apparatus and instruments used in chemical analysis
5. The learners will gain expertise in volumetric titrations qualitatively as well as quantitatively.

Course code: WSCHEMJ123	**Applied Chemistry**	**02 Credits**
Paper I	**Synthetic Chemistry** 1. Green synthesis of benzilic acid from benzil 2. Green synthesis of the Ni-DMG complex. **Estimations** 1. Estimation of tincture iodine. 2. Estimation of acetic acid in a sample of vinegar (Titrimetry) 3. 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).	
Paper II	**Synthetic Chemistry** 1. Synthesis of Schiff's Bases 2. Synthesis of Chalcones **Estimations** 1. Determination of the amount of magnesium hydroxide in a commercial sample of milk of magnesia. 2. Estimation of aspirin (Acid-Base titration) 3. Estimation Ibuprofen in the given sample (Back titration method)	

References

1.Vogel's Textbook of practical organic chemistry
2.Name Reactions and Reagents in Organic Synthesis" by Bradford P. Mundy, Michael G. Ellerd, and Frank G. Favaloro Jr.
3. Organic Chemistry" by Jonathan Clayden, Nick Greeves, and Stuart Warren
4. Organic Synthesis: Strategy and Control" by Paul Wyatt and Stuart Warren

Programme(s): F.Y.B Sc	SEMESTER:II				
Course: Indian Knowledge System	Course Code: WSCHEIK121				
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA-I)	Continuous Assessment (CA-II)
2.0	NA	NA	02	Marks- 30	Marks- 30

Learning Objectives:

1. To learn about the evolution of Indian medicinal chemistry and its cultural significance.
2. To analyze the influence of Indian medical knowledge on the development of modern medications.
3. To list and explain the major contributions of early Indian scientists to medicinal chemistry.
4. To assess Indian medicinal chemistry's socio cultural and scientific components using critical thinking.
5. To examine Ayurveda's tenets and practices, as well as their applicability to Indian healthcare.
6. To recognize the importance of preserving and incorporating traditional Indian medicine into modern healthcare systems and to convey to a variety of audiences the evolution of Indian medical chemistry effectively.

Course Outcomes:

The learners will be able to-

1. Explain the history and cultural significance of Indian medicinal chemistry, focusing on its origins in ancient Indian traditions.
2. Describe the significant contributions of ancient Indian intellectuals to the study of medicinal chemistry, such as Charaka, Sushruta, and Nagarjuna.
3. Analyze Ayurvedic medicine's ideas and practises, including the concept of tridosha, medicinal herbs, and formulation processes.
4. Assess the impact of Indian medical knowledge on modern drug discovery and the creation of novel therapeutic agents.
5. Discuss why it is critical to integrate ancient Indian medicinal practices with modern healthcare systems in order to promote holistic and personalized medicine.
6. Effectively communicate the history and development of Indian medicinal plants through written reports and spoken presentations.

Course code:WSCHEIK121	Unit	Course Title : History and Development of Indian Medicinal Chemistry	02 Credits/ 30 Lectures
	I	**Introduction to Indian Medicinal Chemistry**	**15 L**
		1) Overview of Indian medicinal traditions and their historical significance 2) Indian medicine's cultural and philosophical aspects 3) Ancient Indian Scholars and Their Contributions: Charaka, Sushruta, and other prominent scholars in Indian medicinal chemistry, their contributions to understanding medicinal plants and formulations 4) Principles and Practices of Ayurveda: Introduction to Ayurvedic medicine and its theoretical foundations. The concept of tridosha and its application in diagnosis and treatment. 5) Medicinal Plants in Indian Medicine: Overview of important medicinal plants used in Indian medicine. Traditional knowledge and extraction techniques for plant-based medicines. 6) Ayurvedic Preparation Methods and Formulations: Powders, decoctions, oils, and other Ayurvedic dosage forms.	
	II	**Indian Medicinal Chemistry and Modern Drug Discovery.**	**15 L**
		1) Indian medicinal knowledge's impact on current drug discovery. Case studies of effective drug development using traditional Indian treatments. 2) Importance of integrating traditional Indian medicinal practices with modern healthcare systems 3) Challenges and opportunities in bridging the gap between traditional and modern medicine. 4) Considerations for Ethics and Sustainability: Ethical issues in the commercialization of traditional Indian medicine. Sustainability concerns in the collection and conservation of medicinal plants 5) Future Prospects	

References:

1) "The Roots of Ayurveda" by Dominik Wujastyk
2) "Charaka Samhita" by Dr. R.K. Sharma and Dr. Bhagwan Dash.
3) "Sushruta Samhita" by Dr. P.V. Sharma.
4) "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare
5) "Ayurveda and Modern Drug Development" edited by S. Bharati and P.M. Unnikrishnan

Theory Examination Pattern:

Modality of Assessment

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

Sr. No.	Evaluation Type	Marks
1	**Written Examination**	**20**
2	**Assignment/ Case study/ field visit report/ presentation/ project**	**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, 20 marks on each unit
   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	Units (I + II + III)
Q.5	Compulsory	12	Units (I + II + III)
	TOTAL	**60**	

Practical Examination Pattern:

A. Internal Examination: 40%- 40 Marks

Particulars	Paper I	Paper II
Journal	05	05
Experimental tasks	10	10
Participation	05	05
Total	**20**	**20**

B. External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Paper I	Paper II
Viva	05	05
Experimental tasks	25	25
Total	**30**	**30**

PRACTICAL BOOK/JOURNAL

The students are required to perform 75% of the Practical for the journal to be duly certified.
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.

Overall Examination & Marks Distribution Pattern

Semester I & II

Course	I & II			I & II			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Document stating nature of evaluation for various courses.

Type Of Course	Nature of Evaluation
Major/Minor subject Courses	Will be a based on continuous internal evaluation – 40 marks(nature of evaluation to be selected from the table 1 below) and a semester end examination – 60 marks.
Open/Generic Electives	Will be based on 2 assignments(nature of assignments to be selected from the table 1 below) each of 30 marks, total 60 marks.
Skill Enhancement Course	Will be based on single semester end exam of 60 marks.
Vocational Skill Course	Will be based on single semester end exam of 60 marks.
Value Education Course	Will be based on 2 assignments(nature of assignments to be selected from the table 1 below) each of 30 marks, total 60 marks.
Indian Knowledge Systems Course	Will be based on 2 assignments(nature of assignments to be selected from the table 1 below) each of 30 marks, total 60 marks.
Ability Enhancement Course	Will be based on single semester end exam of 60 marks.
NSS/NCC/ Co-Curricular course/ Field Project/ Research project/ On Job Training/ Internship	Will be directly graded on a set of methods chosen from table 2 below.(Rubrics will be set up by each agency in consultation with the exam department).

Table 1

Modes of Assessment	Time to be spent by student.
Class Tests, Quizzes, Class Assignment, presentations.	Between 1 ~ 2 minutes for one mark.
Take home exam, home assignments, surveys, projects, out of campus activities.	Between 15 ~ 20 minutes for one mark.
Open book tests, Unsupervised exams, tutorials, on campus activities.	Between 5 ~ 10 minutes for one mark.
Term papers	1 hour work per mark.
Journal entries, Viva, Extension experiments, Skills tests, Projects. (For practical courses only)	Up to 30% of time allotted for practicals

Table 2

Modes of Assessment	Time to be spent by student.
Tests, Essays, articles.	1 hour per credit
Group assignments	5 hours per credit
Reports, Reflective journals, Diaries.	5 hours per credit.
Portfolios, Dissertations, Reviews	5 hours per credit.
Observation of students	As per nature of the course