

<i>First Semester</i>										
Sl. No.	Type	Course Name	Course code	Class Load/Week			Credit	Class load/	Marks	Remarks
				L	T	P				
1	MAJ-I	Fundamentals of Chemistry-I		3	1	0	4	4	100	Major Course
2	MAJP-I	Major Practical (Inorganic)		0	0	3	2	3	50	Major Practical
3	MIN-I						4		100	Minor Course
4	VAC-I	Environmental Science		3	0	0	3	3	100	Value Added Course
5	MDC-I			3	0	0	3	3	100	Multidisciplinary Course
6	AEC-I	English Language		3	0	0	3	3	100	Ability Enhancement Course
7	SEC-I	Workshop		3	0	0	3	3	100	Skill Enhancement Course
	Total						22			
<i>Second Semester</i>										
Sl. No	Type	Course Name	Course code	Class Load/Week			Credit	Class load/	Marks	Remarks
				L	T	P				
1	MAJ-II	Fundamentals of Chemistry-II		3	1	0	4	4	100	Major Course
2	MAJP-II	Major Practical (Physical)		0	0	3	2	3	50	Major Practical
3	MIN-II						4		100	Minor Course
4	VAC-II	Health, Fitness, Wellness and Yoga		3	0	0	3	3	100	Value Added Course
5	MDC-II			3	0	0	3	3	100	Multidisciplinary Course
6	SEC-II	Basic Computer Programming		3	0	0	3	3	100	Skill Enhancement Course
7	AEC-II	Indian Language		3	0	0	3	3	100	Ability Enhancement Course
	Total						22			
Exit: One year UG Certificate										
<i>Third Semester</i>										
Sl. No	Type	Course Name	Course	Class Load			Credit	Class load	Marks	Remarks
				L	T	P				
1	MAJ-III	Physical Chemistry-I		3	1	0	4	4	100	Major Course
2	MAJ-IV	Organic Chemistry-I		3	1	0	4	4	100	Major Course
3	MAJP-III	Major Practical (Organic)		0	0	3	2	3	50	Major Practical
5	MIN-III						4		100	Minor Course
6	MDC-III						3	3	100	Multidisciplinary Course
7	SEC-III	AI and ML					3	3	100	Skill Enhancement Course
8	AEC-III						2	3	50	Ability Enhancement Course

7	MAJH-II	Inrganic Chemistry-HI		3	0	0	3	3	100	Only for Four years UG Honours
8	MAJH-II	Physical Chemistry-HI		3	0	0	3	3	100	Only for Four years UG Honours
9	MAJHP-I	Physical Practical-HI		0	0	3	2	2	50	Only for Four years UG Honours
10	MAJHP-I	Inorganic Practical-HI		0	0	3	2	2	50	Only for Four years UG Honours
Total							20			Total Credit for Four years UG Honours

Exit: (i) Four Years UG Degree (Honours) (ii) Four Years UG Degree (Honours with Research) (iii) One year PG diploma for students enrolled for Two Years PG Program after Three years UG degree holders

Entry: One Years PG Program for Four years UG degree holders

Ninth Semester

Sl. No	Type	Course Name	Course	Class Load/Week			Credit	Class load/	Marks
			Code	L	T	P			
1	MAJ-XXI	Physical Chemistry VI		3	1	0	4		100
2	MAJ-XXII	Organic Chemistry VI		3	1	0	4		100
3	MAJ-XXIII	Inorganic Chemistry VI		3	1	0	4		100
4	P	Thesis Progress Report					4		100
5	O	Project Seminar					2		50
6	O	Viva-voce					2		50
7	P	Research Methodology					2		50
Total							22		

Tenth Semester

Sl. No	Type	Course Name	Course	Class Load/Week			Credit	Class load/	Marks	
			Code	L	T	P				
1	MAJ-XXIV	Departmental Elective		3	1	0	4	4	100	Major Course
2	MAJ-XXV	Departmental Elective		3	1	0	4	4	100	Major Course
3	P	Project Final Report					6		150	
4	P	Project Final Seminar					4		100	
5	O	Viva Voce					2		50	
Total							20		500	

Exit: (i) One Year PG Degree for Four Years UG Degree Holders (ii) Two years PG degree for Three Years UG Degree Holders

BS-MS in Chemistry

1st Semester

Course Code	CH1102N	Course Name	Basic Concepts of Chemistry – I	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	Basics Concepts of Chemistry – II
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	Students will learn some basic concepts of chemistry which includes idea of wave mechanical properties of atoms, and fundamental concepts of thermodynamics, understanding the structure, properties, and reactions of carbon-containing compounds, providing a foundation for studying the core principles like bonding, functional groups, stereochemistry, and reaction mechanisms.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Extra nuclear structure of atoms Wave-Particle duality; de Broglie hypothesis, Heisenberg's uncertainty principle, Schrödinger's wave equation, Concept of Atomic Orbital, Radial and angular wave functions for hydrogen atom, Radial and angular distribution curves, shapes of <i>s</i> , <i>p</i> and <i>d</i> orbitals, Radial and angular distribution, Quantum numbers and their significance, Aufbau principle and its limitations; Pauli's exclusion principle; Hund's rules and multiplicity, Ground state Term symbols of atoms and ions for atomic number upto 30, Effective nuclear charge, Shielding and penetration, Slater's rule.	10	Students will gain basic ideas about the wave mechanical model of an atom, the concept of atomic orbital and ground state terms.
II	Basics of Organic Chemistry <i>Shapes of organic molecules and electronic influence effect:</i> Atomic orbitals, Shapes of atomic orbitals, Molecular orbitals and Covalent bond formation, Hybridization, Multiple covalent bonds, Inductive effect, Field effect, Resonance, Mesomeric effect, Hyperconjugation, Steric effect, Bond energy, Bond length, Dipole moment, Hydrogen bonding, Tautomerism, Reaction intermediates (Carbocation, Carbanion, Free radical, and Arynes); Aromaticity: Huckel Rule and MO theory,	18	Students will learn fundamentals of bonding, hybridisation, atomic and molecular orbitals. Organic acid/base, aromaticity and stereochemical projection formulas such as Fischer, Newman, Sawhorse, Flying-Wedge and Zigzag presentation will be demonstrated.

	<p>aromatic, non-aromatic, antiaromatic, homoaromatic compounds</p> <p><i>Organic Acids and Bases:</i> Factors that influence the acidity and basicity, and Examples</p> <p><i>Basic Stereochemistry I:</i> Symmetry elements, Optical activity, Chirality, Enantiomers, Diastereoisomers, Racemic modification, Chiral resolution, Optical purity, Projection structures of stereoisomers (Fischer, Newman, Sawhorse, Flying Wedge, and Zigzag)</p> <p><i>Energetics of Reactions:</i> Stability, Equilibrium constant, $\Delta G = -RT \ln K$, $\Delta G = \Delta H - T\Delta S$, Kinetics of reaction, rate of a reaction, order of a reaction, Reaction profiles and mechanism, Activation energy, Transition state, Intermediate, Rate determining step, Exothermic and Endothermic processes, Thermodynamic control and Kinetic control reaction, Reversibility, Catalysis, Principle of microscopic reversibility, Primary kinetic isotope effect, Secondary kinetic isotope effect</p>		
III	<p>Chemical Thermodynamics</p> <p>Recapitulation of Zeroth and first law, Carnot Engine, Second law of thermodynamics along with Kelvin-Planck and Clausius statements, Third Law of Thermodynamics, entropy change accompanying various processes, Helmholtz and Gibbs energy and their significance, Dependence of auxiliary functions on various parameters, Maxwell relations, Gibbs-Helmholtz equation, Chemical potential and other partial molar properties and inter relations, Criteria of spontaneity, T, P dependence of μ, Maxwell relations with chemical potential. Gibbs –Duhem equation. Thermodynamic equilibrium, Chemical Equilibrium- Gibbs energy as a function of extent of reaction. Law of mass action and the equilibrium constants (K_p-K_c relation). Variation of equilibrium constant with temperature and pressure. Le Châtelier and Le Châtelier-Braun principle.</p>	28	Students will understand the thermodynamic principle for various chemical and physical processes. Moreover they will gain knowledge about spontaneity and equilibrium of various processes.

	Applications of thermodynamics in phase equilibrium (one- and two-component systems (five phase diagrams: Water, Cu-Ni and Pb-Sb system. Sn-Mg, Na ₂ SO ₄ -H ₂ O mixture, and Fe-C)). Demonstration of Phase rule (with derivation), special points, and lever rule from the diagrams		
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Course Outcome	<ol style="list-style-type: none"> To gain basic knowledge about the wave mechanical model of an atom, the concept of Atomic Orbital and ground state terms. Students will be able to: (i) explain the fundamental concepts of organic chemistry, including atomic structure, covalent bonding, hybridization, and functional groups; (ii) illustrate the basic principles of acidity, basicity, and electronic effects in organic molecules; (iii) learn stereochemistry (isomers), and applying principles to predict reactivity. Students should be able to explain the thermodynamic principle for various chemical and physical processes and thereby be able to analyze real-world physical systems exploiting thermodynamic principles and connect them to microscopic nature.
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Learning Resources	<ol style="list-style-type: none"> Cotton, F. A., Wilkinson, G., and Gaus, P. L., <i>Basic Inorganic Chemistry</i>, 3rd Ed., Wiley India. Shriver, D. F. and Atkins, P., <i>Inorganic Chemistry</i>, 5th Ed., Oxford University Press. Huheey, J. E., Keiter, E. A., and Keiter, R. L., <i>Inorganic Chemistry: Principles of Structure and Reactivity</i>, 4th Ed., Harper Collins, 1993, Pearson. Douglas, B. E. and McDaniel, D. H., <i>Concepts & Models of Inorganic Chemistry</i>, Oxford, 1970. Sharpe, A. G., <i>Inorganic Chemistry</i>, 4th Indian Reprint, Pearson Education. Housecroft, C. E. and Sharpe, A. G., <i>Inorganic Chemistry</i>, 5th Edition, Pearson. Wulfsberg, G., <i>Inorganic Chemistry</i>, Viva Books Private Limited. Castellan, G. W., <i>Physical Chemistry</i>. Atkins, P. and de Paula, J., <i>Atkins' Physical Chemistry</i>. Zemansky, M. W. and Dittman, R. H., <i>Heat and Thermodynamics</i>. Smith, E. B., <i>Basic Chemical Thermodynamics</i>. Denbigh, K. G., <i>The Principles of Chemical Equilibrium</i>. McQuarrie, D. A. and Simon, J. D., <i>Molecular Thermodynamics</i>. Glasstone, S., <i>Thermodynamics for Chemists</i>. Klotz, I. M. and Rosenberg, R. M., <i>Chemical Thermodynamics</i>. Organic Chemistry, Clayden, N. Greeves, S. Warren and P. Wothers, (Oxford University Press) Principle of organic synthesis -R.O.C. Norman & J. M. Coxon. Advanced Organic Chemistry – Jerry March Stereochemistry of Organic Compound – D. Nosipuri Stereochemistry of Carbon Compound – E.L. Eliel
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Course Code	CH1172N	Course Name	Inorganic Practical– I	Course Category	PC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	Inorganic Practical– II
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To develop hands-on laboratory skills and to understand the underlying principles in acid-base and redox titrimetric analysis.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Estimation of carbonate and bicarbonate present together in a mixture	6	Students will learn different titrimetric analysis such as acid base, dichromatometry, permanganometry and iodometry. They will also learn how to analyze samples having more than one analyte.
II	Estimation of carbonate and hydroxide present together in a mixture.	6	
III	Estimation of acetic acid in vinegar	6	
IV	Estimation of Fe(II) using KMnO_4 solution	6	
V	Estimation of Fe(III) using $\text{K}_2\text{Cr}_2\text{O}_7$ solution	6	
VI	Estimation of Fe(II) and Fe(III) in a given mixture using $\text{K}_2\text{Cr}_2\text{O}_7$ solution	6	
VII	Iodometric estimation of copper	6	

Course Outcome	Students will gain an understanding of: 1. the fundamentals of acid/base equilibria, including pH calculations, buffer behavior, acid/base titrations 2. the fundamentals of different redox titration, equivalent weight, behaviour of indicator.
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Learning Resources	1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Harris, D. C.; Lucy, C. A. (2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company
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2nd Semester

Course Code	CH1202N	Course Name	Basics Concepts of Chemistry – II	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	<p>To provide basic</p> <ol style="list-style-type: none"> 1. the concepts of periodic table and periodic properties 2. the concepts of theories of acids and bases 3. The concepts of kinetic theory of gasses 4. The primary objective of substitution and elimination reactions in organic chemistry is the conversion of organic functional groups to synthesize a diverse array of desired compounds with specific properties. These reactions serve as fundamental tools in organic synthesis to modify the structure and properties of both aliphatic and aromatic compounds.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	<p>Periodic Properties Modern IUPAC Periodic table, atomic radii, ionic radii, covalent radii, ionization energy, electron affinity and electronegativity, Group trends and periodic trends in these properties in respect of <i>s</i>-, <i>p</i>- and <i>d</i>-block elements, Electronegativity scales (Pauling's, Mulliken's and Allred-Rochow's scales), scandide contraction, lanthanide contraction, Secondary periodicity, Relativistic Effect, Inert pair effect.</p>	14	Students will learn periodic properties with knowledge of periodicity in physical and chemical behaviors of the elements
II	<p>Acids and bases Arrhenius concept, theory of solvent system (H₂O, NH₃, SO₂ and HF), Bronsted-Lowry's concept, relative strength of acids, Pauling's rules, Lux-Flood concept, Lewis concept, characteristics of Lewis acids, solvent levelling and differentiating effects; Thermodynamic acidity parameters, Drago-Wayland equation; superacids, Gas phase acidity and proton affinity; HSAB principle.</p>	10	Students will learn fundamental of acid base theories along with thermodynamic acidity parameters

III	<p>Substitution Reactions (aliphatic and aromatic) and Elimination</p> <p><i>Substitution Reactions:</i> S_N2, S_N1, S_Ni, S_N1', S_N2', S_Ni', NGP, substitution at allylic carbon, vinyl carbon, and their stereochemical aspects with NGP, Aromatic electrophilic substitution reactions (nitration, sulfonation, halogenation, Friedel-Crafts reaction, with their mechanism), Ipso substitution reactions</p> <p>Aromatic Nucleophilic substitution reaction (Benzyne mechanism, elimination-addition mechanism, Von Richter reaction)</p> <p>Elimination Reactions: E1, E2, E1cB, and E_i (Pyrolytic Syn elimination)</p>	18	<p>Students will learn the fundamentals of an organic transformation such as stability, equilibrium constant, free-energy changes, reaction rate, reaction order, activation energy, and R/D step. The basic idea of S_N1, S_N2, S_Ni, S_N1', S_N2', S_Ni' and elimination reactions will be explained with emphasis on mechanisms, kinetics, stereochemistry, and reaction conditions. Aromatic nucleophilic and electrophilic substitution reactions will also be taught.</p>
IV	<p>Kinetic theory of Gases</p> <p>Basic idea of probability, probability density and probability distribution function. Characters and significance of Gaussian function, interpretation of pressure, temperature, and energy from kinetic theory, Nature of distribution of molecular velocity and speed in one, two and three dimensions. The Maxwell-Boltzmann distribution of molecular speeds. Kinetic energy distribution in one, two and three dimensions. Significance and application of the Maxwell-Boltzmann distribution such as fraction having at least a critical energy etc, Principle of equipartition of energy. Molecular basis of heat capacity of gases. Temperature variation of heat capacity. Collision of gas molecules-collision diameter and collision frequency. Mean free path. Wall collision frequency and effusion. Macroscopic Transport Phenomena (Fick's law of diffusion and Fourier's law of heat conduction).</p>	14	<p>Students will learn about molecular speed distribution of gas molecules, and connect the random motion and collisions of molecules to observable gas properties like pressure, temperature, and volume. Students will also acquire knowledge about transport phenomena of gases</p>

Course Outcome	<p>Students will gain knowledge of:</p> <ol style="list-style-type: none"> 1. the periodic table and periodic properties 2. the fundamentals of acid/base chemistry, including pH calculations, buffer behavior, and acid/base titrations
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	<ol style="list-style-type: none"> 3. Substitution and elimination, these two reaction strategies allow understanding to transform basic starting materials into a vast array of specialized molecules, enabling innovation across scientific and industrial fields. 4. molecular speed distribution and calculate characteristic velocities of gases using Maxwell–Boltzmann statistics 5. transport properties of gases such as viscosity, thermal conductivity, and diffusion based on molecular motion and mean free path.
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Learning Resources	<ol style="list-style-type: none"> 1. Cotton, F.A., Wilkinson, G. and Gaus, P.L., <i>Basic Inorganic Chemistry</i>, 3rd Ed.; Wiley India. 2. Atkin, P. Shriver & Atkins', <i>Inorganic Chemistry</i>, 5th Ed., Oxford University Press. 3. Huheey, J. E.; Keiter, E.A. & Keiter, R.L., <i>Inorganic Chemistry: Principles of Structure and Reactivity</i>, 4th Ed., Harper Collins 1993, Pearson. 4. Douglas, B.E. and McDaniel, D.H., <i>Concepts & Models of Inorganic Chemistry</i>, Oxford, 1970. 5. Sharpe, A.G., <i>Inorganic Chemistry</i>, 4th Indian Reprint, Pearson Education. 6. Housecraft, C. E.; Sharpe, A. G., <i>Inorganic Chemistry</i>, 5th Edition, Pearson. 7. Wulfsberg, G., <i>Inorganic Chemistry</i>, Viva Books Private Limited. 8. Sears, F. W. and Salinger, G. L., <i>Thermodynamics, the Kinetic Theory of Gases and Statistical Mechanics</i>. 9. Kauzmann, W., <i>Kinetic Theory of Gases</i>. 10. Castellan, G. W., <i>Physical Chemistry</i>. 11. Atkins, P. and de Paula, J., <i>Atkins' Physical Chemistry</i>. 12. Ball, D. W., <i>Physical Chemistry</i>, Thomson Press. 13. Levine, I. N., <i>Physical Chemistry</i>, Tata McGraw-Hill. 14. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012. 15. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003. 16. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited. 17. Advanced Organic Chemistry – F.A.Carey & R.J. Sundberg. 18. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
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Course Code	CH1272N	Course Name	Physical Practical– I	Course Category	PC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To introduce measurement of basic properties and its use to find out relevant chemical properties and to provide student hands-on experience.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Finding the average molecular weight of polystyrene by viscosity measurement.	6	Learn application of Transport processes in solution. Learn to use isoelectric points, an important parameter to characterize polypeptides. Learn to measure heat of solution during mixing. Learn the application of phase rules in mixed Solutions. Learn to verify theories learned in conductivity.
II	Determination of CMC by surface tension/DLS measurement.	6	
III	Determination of the isoelectric pH of gelatin	6	
IV	Determination of the heat of neutralization of a strong acid by a strong base/Determination of the heat of solution of Benzoic acid in water	6	
V	Determination of the solubility curve of two and three-component systems	6	
VI	Determination of the partition coefficient of benzoic acid between toluene and water	6	
VII	Verification of Ostwald's dilution law and determination of the dissociation constant conductometrically	6	

Course Outcome	<ol style="list-style-type: none"> Students will gain practical knowledge on transport processes, and thermodynamic properties They will also acquire practical analytical skills in solution chemistry, thermochemistry, electrochemistry The hands-on experience will equip them for roles in laboratories where precise measurement and data interpretation are essentially required
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Learning Resources	<ol style="list-style-type: none"> Fundamentals of Analytical Chemistry –D.A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, 9th Ed., Cengage Learning, 2013 Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency A Collection of Interesting General Chemistry Experiments – A.J. Elias, Sangam Books Ltd
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MDC Course for other Department to be offered in the 2nd semester

Course Code	CH1261N	Course Name	Chemistry in Everyday Life	Course Category	MDC	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
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Course Offering Department	Chemistry	Data Book / Codes/Standards	None
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Course Objectives	Making students aware of chemistry and chemical reactions involved behind various processes and items from everyday life.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Chemistry of Food Additives Chemicals used as Preservatives (benzoates, propionates, sorbates etc.), Antioxidants, Coloring agents, Flavoring agent (Vanniline, alkyl esters, MSG its applications and side effects, Emulsifiers, Artificial Sweeteners: structure, function and examples. FSSAI approved food additives. Fermentation process in food industry	14	Explain the chemistry of food additives, preservatives, antioxidants, colorants used in daily life
II	Chemistry of Cosmetics Composition and formulation of soaps, shampoos, creams, lotions, lipsticks, and hair dyes. General formulation of perfumes, and composition and function of deodorants and antiperspirants. application and side effects of cosmetic products; composition of talcum powder	14	Learn the composition, formulation, applications, and potential side effects of cosmetics
III	Chemistry of Pesticides & Herbicides Natural and synthetic pesticides: uses, benefits, and adverse effects. Pesticides: classification, production, application and toxicity. Their structure-activity relationships. Preparation, industrial production, and applications of selected pesticides from the following chemical classes: organochlorines (DDT, Gammexene), organophosphates (Malathion, Parathion), quinones (Chloranil), anilides (Alachlor, Butachlor) and carbamates (Carbofuran, Carbaryl). Herbicide classification, selectivity, uptake, chemistry, Mode of action (Dichlorobenzyl, Dalapon, Aromatic Carbamates, Diuron and monouron, Triazines- Atrazine, Enothal, Paragat, Phenoxy herbicide- 2,4D and 2,4,5-T)	14	Understand the chemistry and toxicology of pesticides and herbicides, and their structure-activity relationships

Course Outcome	<ol style="list-style-type: none"> 1. Students will understand the chemistry of food : preservatives, antioxidants, colorants, flavoring agents etc used in daily life 2. They will be able to explain the composition, formulation, applications, and potential side effects of cosmetics 3. Students will get insights about the chemistry, and toxicology of pesticides and herbicides, including structure–activity relationships 4. Overall, the students will be able to apply chemical knowledge to evaluate the safety, efficacy, and environmental impact of food additives, cosmetics, and agrochemicals in daily life
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Learning Resources	<ol style="list-style-type: none"> 1. Edward Cox Henry, The Chemical analysis of Foods , Hardcover , Hassell Street Press , 2021 2. Food Chemistry Lilian Hoagland Meyer, CBS 3. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015. 4. Thomas. E. Furia, “Handbook of food additives” 2nd Edition, Volume 2, CRC press, 1980 2. P. Bailey. A.E.” Industrial oils and Fat products” Inter science Publishers 5. Mathew G. G. D. Chemistry in Everyday Life. Delhi: Vishal, 2014. 6. B.M. Mithal and R.N. Saha, A Handbook of cosmetics, 2006,; Published by M.K. jain for Vallabh Prakashan. 7. R. Cremlyn: Pesticides, John Wiley. 8. H.Ohkawa , H. Miyagawa, P.W. Lee, Pesticide Chemistry, Wiley-VCH,2007,ISBN: 978-3527-31663-2
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3rd Semester

Course Code	CH2101N	Course Name	Physical Chemistry-I	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	Physical Chemistry-II
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To provide student foundational knowledge on real gases, solutions and electrochemistry.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Real Gases Deviation from ideal behavior in gas and real-gas equation of state, Law of	14	Student will learn about the behaviour of real gas, concept of fugacity, and

	<p>corresponding state, Virial equation of state, van der Waals' form of the second virial coefficient and the significance of the second virial coefficient. Fugacity, fugacity coefficient. Choice of standard states of real gases Principle of estimation of fugacity. Mixture of real gases: Chemical potential and fugacity of a real gas in a mixture. Choice of standard states of real gases in a mixture, Isotherms of real gases and comparison with van der Waals isotherms, continuity of states, critical states.</p>		<p>thermodynamic behavior of real gases and their mixtures</p>
II	<p>Ideal solution and colligative properties Thermodynamics of Systems in Condensed Phase, Ideal solutions: Raoult's law and thermodynamic definition. Definition and Chemical potential of a component in an ideal solution. Thermodynamics parameters of mixing of ideal solutions, Ideally Dilute Solution: Henry's law. Definition and choice of standard states of solvent and solutes. Colligative properties: Boiling Point Elevation, Freezing Point Depression, Osmotic Pressure, Vapor Pressure Lowering.</p>	14	<p>Students will learn about thermodynamics of ideal solution, application of thermodynamics including phase equilibria, colligative properties. The principles of ideal solutions and colligative properties helps students to solve quantitative problems related to vapor pressure lowering, boiling point elevation, and freezing point depression.</p>
III	<p>Non-ideal solution Chemical potentials of the components of a real solution. Activity and activity coefficients. Gibbs-Duhem equation applied to activity coefficient (osmotic coefficient), Conventions regarding the standard states and activity coefficients. The molality and molarity scales of activity coefficients and the respective standard states. Choice of standard states of solids and liquids. Activity of pure solids and pure liquids. Extension of the activity concept to gases.</p>	14	<p>Students will learn about the properties of non-ideal solutions and open systems which are vital for applying chemical principles to real-world processes like distillation, chemical synthesis, and environmental modeling, where non-ideality is the norm rather than the exception.</p>
IV	<p>Fundamentals of electrochemistry Experimental determination of activity coefficients of electrolytes and non-electrolytes, concepts of entropy productions, forces & fluxes,</p>	14	<p>Student will learn about activity coefficients, ion transport, and electrochemical cell behavior</p>

	<p>phenomenological coefficient, Onsager reciprocal relations and their applications, coupled reactions. Ionics: Electrochemistry of solutions, Ion atmosphere and Debye – Huckel – Onsager equation. Ion-solvent interactions, ion-ion interactions, ionic migration and diffusion. Phenomenological description of transport processes. Thermodynamics of galvanic cells: Equilibrium electrode potentials, IUPAC convention for electrode potentials, Thermodynamics of electrochemical cells and applications.</p>		
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<p>Course Outcome</p>	<ol style="list-style-type: none"> 1. Students will gain knowledge about behaviour of real gas, isotherms. They will obtain insights about thermodynamics of open systems, mixing in solutions. 2. Students will understand the thermodynamics of ideal solutions. They will be able to explain and apply colligative properties like vapor pressure lowering, boiling point elevation, and freezing point depression 3. Upon completing a course on non-ideal solutions, a student is expected to be able to apply concepts of activity and activity coefficients to perform calculations and more accurately predict the properties (like chemical potential or osmolality) of real, non-ideal multi-solute solutions in industrial or research contexts. 4. Students will learn electrochemistry including activity coefficients, Debye–Hückel–Onsager theory, and the thermodynamics and applications of electrochemical cells
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<p>Learning Resources</p>	<ol style="list-style-type: none"> 1. Physical Chemistry by G. W. Castellan 2. Atkins' Physical Chemistry by Peter Atkins and Julio de Paula 3. An introduction to electrochemistry by Samuel Glasstone 4. Levine, I. N. Physical Chemistry 5. Moore, W. J. Physical Chemistry 6. Physical Chemistry by T. Engel and P. Reid 7. Basic Chemical Thermodynamics by E. B. Smith 8. The Principles of Chemical Equilibrium by K.G. Denbigh 9. Electrochemical Methods: Fundamentals and Applications – A.J. Bard and Larry R. Faulkner. 10. Modern Electrochemistry – J.O.M. Bockris & A.K. N. Reddy – Vol. 2A & 2B
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Course Code	CH2102N	Course Name	Organic Chemistry - I	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To develop a comprehensive understanding of organic molecules, their structure, properties, and the mechanisms of their reactions.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Addition Reactions (alkenes and alkynes): Hydrogenation, addition of Br ₂ , Cl ₂ , HX, hydration, Hydroboration, hydroxylation, Woodward and Prevost reaction, KMnO ₄ , OsO ₄ , Pb(OAc) ₄ , epoxydation, ozonolysis, SeO ₂ , dehydrogenation	14	Students will learn the concepts of mechanism and regio-/stereoselectivity of different addition reactions across alkenes and alkynes.
II	Chemistry of Alkynes and Alcohols: Reduction of alkynes, protection, dehydration, and preparation of 1°, 2°, 3° alcohols, Oxidation of alcohols (Swern's oxidation, PCC, PDC, K ₂ Cr ₂ O ₇ /H ₂ SO ₄ , Oppenauer method, oxidation of diols), glycol cleavage	8	The students will be introduced to various oxidising agents and oxidation methods. The reductive protocol of alkynes leading to alkenes and alkanes and different protection techniques will be discussed.
III	Carbonyl Chemistry: Carbonyl activity, addition of water, alcohols, thiols, HCN, HCl, NaHSO ₃ , ammonia, aryl amine, hydroxyl amine, hydrazine, phenyl hydrazine, semicarbazide, and 2,4-DNP, HNO ₂ , Stork enamine alkylation, Reduction of carbonyl compounds (Wolf-Kishner reduction, LiAlH ₄ , NaBH ₄ , NaBH ₃ CN, M.P.V. reduction, Rosenmond reduction, Li/NH ₃ (l)), Clemenson reduction, Eschwiler-Clarke Methylation, Mannich reaction, Robinson annulation reaction, Wittig reaction, Darzens Glycidic Ester Condensation, Benzoin condensateion, Haloform reaction, Schmidt reaction, Aldol condensateion, Mukaiyama	20	Students will learn the concepts of reactivity of carbonyl compounds toward nucleophiles and other reagents. Various name reactions related to carbonyl group and the carbonyl reducing agents will be discussed thoroughly.

	reaction, Michael reaction, Robinson annulation, Perkin condensateion, Cannizaro reaction, Shapiro reaction, oxidation by SeO ₂ , Tollen's reagent, Baeyer-Villiger reaction		
IV	Stereochemistry II: Concept of stereo centre, Chirotopic centre, Pseudoasymmetric centre, Re and Si, Pref-Pruf, Erythro, Threo, D, L-system, R, S-system, Chiral molecules without chiral centre, Cis-Trans isomer, E and Z, Conformation of acyclic organic molecules, Topicity, point groups.	14	Students will be introduced to the stereochemistry of carbon compounds. The stereochemical terms such as stereocenters, chirotopic centers, pseudoasymmetric centers, and prochiral centers (Re/Si) and different nomenclature systems will be taught in the class.

Course Outcome	<p>1. This knowledge is essential for predicting outcomes of reactions, designing synthetic routes for new compounds, and understanding their applications in various fields like medicine and industry.</p> <p>2. The chemistry of alkenes, alkynes, alcohols, carbonyl compounds, and stereochemistry has extensive practical applications, primarily in the pharmaceutical, polymer, and food industries, where they serve as essential building blocks for diverse commercial products.</p>
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Learning Resources	<p>1. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.</p> <p>2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</p> <p>3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.</p> <p>4. Advanced Organic Chemistry – F.A.Carey & R.J. Sundberg.</p> <p>5. Advance Organic Chemistry: Reaction Mechanisms - B. Reinhard</p> <p>6. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.</p> <p>7. Stereochemistry of Organic Compound – D. Nosipuri</p>
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Course Code	CH2171N	Course Name	Organic Practical– I	Course Category	PC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses		Organic Practical– II	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None		

Course Objectives	The objective is to systematically identify specific organic functional groups using various chemical tests, prepare and purify a characteristic solid derivative to confirm the identity and purity of the unknown compound, and determine its melting or boiling point.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Detection of the following functional groups by systematic chemical tests: aromatic amino (Ar-NH ₂), aromatic nitro (Ar-NO ₂), amido (-CONH ₂ , including imide), phenolic -OH, carboxylic acid (-COOH), carbonyl (distinction between -CHO and >C=O). Preparation and purification of suitable derivatives of organic compounds containing above mentioned functional groups. Determine melting/boiling point of the given compound	21	Students learn the concepts of systematically identifying functional groups such as aromatic amino, aromatic nitro, amido (including imides), phenolic -OH, carboxylic acid, and carbonyl groups using standard chemical tests and solid derivatives.
II	Preparation of important organic compounds: Bromination of aniline or anilides, Nitration of aromatic compounds, side chain oxidation of aromatic compounds, Selective reduction of <i>meta</i> dinitrobenzene to <i>m</i> -nitroaniline, Diazo coupling reaction, Sandmeyer reaction	21	Learn the preparation of important organic compounds through simple reactions.

Course Outcome	Systematic chemical tests, derivative preparation, and melting/boiling point determination are crucial in industry for quality control, product development, purity assessment, and safety compliance. These processes confirm the identity and purity of substances used in manufacturing, particularly in the pharmaceutical, agrochemical, and materials science sectors.
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Learning Resources	<ol style="list-style-type: none"> 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Harris, D. C.; Lucy, C. A. (2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company 3. Fundamentals of Analytical Chemistry –D.A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, 9th Ed., Cengage Learning, 2013 4. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency 5. A Collection of Interesting General Chemistry Experiments – A.J. Elias, Sangam Books Ltd
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Course Code	CH2172N	Course Name	Quantitative Analysis for Real Samples	Course Category	SEC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To make students get a flavor of hands on experience of uses of chemistry for characterization of daily usable product and different analysis of water
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Estimation of free alkali present in different soaps/detergents.	6	Learn to analyze daily usable products and water from various sources.
II	Determination of the amount of acid neutralized by antacid tablets.	6	
III	Estimation of available chlorine in bleaching powder.	3	
IV	Estimation of Vitamin C	3	
V	Determination of the amount of citric acid in fruit juices.	3	
VI	Estimation of Hardness of water	3	
VII	Estimation of chlorine in tap water	3	
VIII	Estimation of fluorine in groundwater	6	
IX	Estimation of arsenic in groundwater	6	
X	Estimation of BOD of pond water	3	

Course Outcome	To develop the skill to analyze daily usable samples and water from different source.
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Learning Resources	<ol style="list-style-type: none"> 1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Harris, D. C.; Lucy, C. A. (2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company 3. Fundamentals of Analytical Chemistry – D.A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, 9th Ed., Cengage Learning, 2013 4. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency 5. A Collection of Interesting General Chemistry Experiments – A.J. Elias, Sangam Books Ltd
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4th Semester

Course Code	CH2201N	Course Name	Physical Chemistry-II	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To provide first introduction of basics of quantum mechanics and origin and consequences of several intermolecular interaction
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Basic Quantum mechanics Basic postulates of quantum mechanics, Generalized uncertainty principle and its applications, Time evolution of the system's states, Stationary states: Time-independent potentials, Properties of one, two and three dimensional quantum mechanical systems (particle in a box, on a ring and on a sphere), Angular momentum operators and their commutator algebra, Harmonic Oscillator (wavefunction and operator methods), Barrier penetration and quantum tunneling. Schrödinger equation: transformation to spherical polar coordinates to solve problems with spherical symmetry, such as the hydrogen atom.	28	Provides the foundation for solving the Schrodinger equations for translational, vibrational, rotational motions & H & H-like atoms, chemical bonds, various properties of matter at the molecular level, and modern applications of quantum mechanics such as quantum communications, quantum computers, quantum dots, etc.
II	Intermolecular forces Introduction to intermolecular forces and their significance. Types of intermolecular forces including ion-dipole, dipole-dipole, dipole-induced dipole, and London dispersion forces. Hydrogen bonding, π -stacking, hydrophobic effect. Comparison between intermolecular forces and intramolecular forces. Role of intermolecular forces in determining	14	This will help students to understand that the forces between molecules dictate a substance's physical state and properties like boiling point, melting point, viscosity, and solubility, by identifying the nature of forces (London dispersion, dipole-dipole, hydrogen bonding, ion-dipole) and relating their strength to molecular polarity and size.

	boiling point, melting point, solubility, viscosity, and surface tension		
III	<p>Colloids</p> <p>Classification of solutes as soluble, insoluble, and colloidal systems. Thermodynamic instability of colloids. Lyophilic and lyophobic sols and their properties. Preparation of colloids and their applications. Origin of electrical charge on colloidal particles, coagulation, and the Schulze–Hardy rule. Zeta potential and the Stern double layer. Electrokinetic phenomena, Stability of colloids in relation to zeta potential and the Tyndall effect.</p>	14	This module provides a comprehensive understanding of the nature, properties, applications, and preparation of colloids in various contexts.

Course Outcome	<ol style="list-style-type: none"> 1. Students will be able to understand and be familiar with the basic models and tools used to solve various quantum mechanical problems 2. Students will also be able to appreciate the wider applications and efficacy of various quantum mechanical tools in chemistry, materials science, and other areas 3. The course will also enhance a student's critical thinking skills to analyze and interpret various quantum phenomena often appearing in chemical and physical systems. 4. Course outcomes for Intermolecular Forces help students to analyze substances at a molecular level. 5. Students are expected to be able to analyze the role of colloids in specific real-world scenarios, industrial processes and everyday life (linking theoretical knowledge to practical applications).
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Learning Resources	<ol style="list-style-type: none"> 1) Introduction to Quantum Mechanics - L.Pauling and E.B.Wilson 2) Molecular Quantum Mechanics - P. Atkins 3) Elementary Quantum Chemistry - F. L. Pilar 4) Quantum Mechanics - J.L.Powell and B. Crasemann 5) Introduction to Quantum Mechanics - D. J. Griffiths 6) Quantum Mechanics: Concepts and Applications - N.Zettili 7) Introductory Quantum Mechanics - R.Liboff 8) Quantum Mechanics - Claude Cohen-Tannoudji 9) Quantum Mechanics in Chemistry - G. C. Schatz and M. A. Ratner 10) Intermolecular and Surface Forces- Jacob N. Israelachvili 11) Handbook of Surface and Colloid Chemistry- K.S. Birdi 12) Physical Chemistry of Surfaces' by Adamson, Arthur W.
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Course Code	CH2202N	Course Name	Organic Chemistry - II	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To develop a deep understanding of how specific atomic groups influence the reactivity of organic molecules and how molecular structures can be intentionally transformed in organic synthesis
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Chemistry of carboxylic acids, esters, amides, oximes, hydroxamic acids, amines (both aliphatic and aromatic): HVZ reaction, decarboxylation, Hunsdiecker reaction, Claisen condensateion, Dieckmann condensation, Dieckmann cyclisation, Stobbe condensation, Knoevenagel reaction, Bauvauit-Black reduction, Acyloin condensateion, Reformatsky reaction, Amide hydrolysis, Hofmann degradation, Schmidt rearrangement, Lossen rearrangement, Curtius rearrangement, Esterification and ester hydrolysis: (B_{Ac}^2 , A_{Ac}^2 , A_{Ac}^1 , E1CB), Nitrenes and isonitrines, Preparation of amines (1° , 2° , and 3°), Chemistry of Diazomethane, Diazoacetic acid, diazoacetic ester, carbene, and nitrene	24	Students will learn the various name reactions of carboxylic acid and acid derivatives. Different esterification mechanisms, and the chemistry of reactive intermediates like carbene and nitrene will be discussed.
II	Chemistry of functional groups of aromatic compounds: nitro compounds, Diazonium salts, and Diazo coupling, Ulman reaction, Phenols, Aryl ethers, Quinones, Aromatic aldehydes and ketones, Reimer Timen reaction, Duff reaction, Vilsmyer Haack reaction, aromatic acids, Birch reduction, Synthesis and reactions of Naphthalenes, Anthracene and phenanthrene	12	The chemistry of aromatic functional groups and the name reactions related to preparation of functionalized aromatic compounds will be discussed in detail. Synthetic methods for polyaromatics will also be taught in this module.

III	Molecular rearrangement: Pinacol-Pinacolone rearrangement, Favorski rearrangement, Fries rearrangement, Allylic rearrangement, Benzil-Benzilic acid rearrangement, Dienone-Phenol rearrangement, Beckmann rearrangement, Bayer Villigar oxidation, Claisen rearrangement, Wolf rearrangement, Wagner-Meerwin rearrangement, Rupe rearrangement, Benzidine-Semidine rearrangement	12	In this module, a series of molecular rearrangement reactions will be taught. The students will acquire knowledge of various molecular rearrangement reactions and their mechanistic pathways.
IV	Amino Acids, Peptides, and Proteins: Amino acids and their classification. α -Amino Acids - Synthesis, ionic properties, and reactions. Zwitterions, pK_a values, isoelectric point, and electrophoresis; Study of peptides: determination of their primary structures, end-group analysis, and methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting, and C-activating groups, Solid-phase synthesis	08	The basic concept of Amino Acids, Peptides, and Proteins will be delivered in this module. Students will learn the techniques of peptide synthesis using N-protecting, C-protecting, C-activating groups and Solid-phase synthesis.

Course Outcome	<ol style="list-style-type: none"> 1. Knowledge of functional groups and rearrangement mechanisms helps select appropriate synthetic scheme and reaction conditions to improve yield, selectivity, and environmental safety (green chemistry principles). This leads to more efficient and cost-effective production methods. 2. The course provides the foundational knowledge for developing novel synthetic methodologies, enabling the creation of complex organic compounds from simpler precursors. This is vital for innovation in various chemical industries. 3. The basic concept of Amino Acids, Peptides, and Proteins will be delivered in this module. Students will learn the techniques of peptide synthesis using N-protecting, C-protecting, C-activating groups and Solid-phase synthesis.
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Learning Resources	<ol style="list-style-type: none"> 1. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012. 2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003. 3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited. 4. Carey, F. A., Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012. 5. Organic Chemistry, Volume 1, I L Finar 6. Advanced Organic Chemistry, A. Cary and R. I. Sundberg, , Part A and B, (Springer). 5. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
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Course Code	CH2203N	Course Name	Inorganic Chemistry-I	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	Inorganic Chemistry-II
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To develop the concepts of <ol style="list-style-type: none"> 1. Redox reactions 2. Ionic bonding 3. Covalent bonding
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Basic principle of redox reactions Elementary idea of standard redox potentials, Nernst equation with derivation, concept of formal potential, influence of complex formation, precipitation and change of pH on redox potentials, redox titration, redox potential at the equivalence point, choice of redox indicator, Redox potential diagram (Latimer, Frost and Pourbaix diagrams) and applications, Disproportionation and comproportionation reactions.	14	Students develop a conceptual understanding of redox processes.
II	Ionic bonding General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Solubility energetics of dissolution process.	14	Students will learn to explain the formation, structure, stability, and properties of ionic compounds.
III	Covalent bonding-I Polarizing power and polarizability, ionic potential, Fajan's rules, Lewis structures, formal charge, Valence Bond Theory, The hydrogen molecule (Heitler – London approach), directional character of covalent bonds,	14	Students will gain knowledge on the formation, structure, stability, and properties of covalent compounds.

	hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rules, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs (examples from main group chemistry) and multiple bonding (σ and π bond approach).		
IV	Covalent bonding-II Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO)) (elementary pictorial approach): sigma and pi-bonds and delta interaction, multiple bonding. Orbital designations: gerade, ungerade, HOMO, LUMO, SOMO, Orbital mixing; MO diagrams of H ₂ , Li ₂ , Be ₂ , B ₂ , C ₂ , N ₂ , O ₂ , F ₂ , and their ions; Heteronuclear molecular orbitals: CO, NO, NO ⁺ , CN ⁻ , HF. Bond properties: bond orders, bond lengths.	14	Students will understand the principle and application of MOT

Course Outcome	Students will develop understanding of: 1. the fundamentals of bonding for both ionic and covalent compounds, including bond distances and bond energies using MO diagrams and thermodynamic data 2. different bonding theories for predicting structures, geometries of simple molecules and important bonding parameters
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Learning Resources	1. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India. 2. Atkin, P. Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press. 3. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson. 4. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970. 5. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education). 6. Housecraft, C. E.; Sharpe, A. G., Inorganic Chemistry, 5 th Edition, Pearson. 7. Wulfsberg, G., Inorganic Chemistry, Viva Books Private Limited.
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Course Code	CH2271N	Course Name	Inorganic Chemistry Practical-II	Course Category	PC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
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Course Offering Department	Chemistry	Data Book / Codes/Standards	None
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Course Objectives	To develop 1. the analytical ability for quantitative inorganic analysis 2. the synthetic skill
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Estimation of Fe(III) and Mn(II) in a mixture using standardized KMnO_4 solution	3	Students will learn to apply quantitative redox titration for analysis of samples with more than one analyte, underlying chemistry.
II	Estimation of (i) arsenite and (ii) antimony iodometrically	6	
III	Estimation of Fe(III) and Cr(III) in a mixture using $\text{K}_2\text{Cr}_2\text{O}_7$	6	
IV	Estimation of Cu in brass	3	
V	Estimation of Cr and Mn in Steel	6	
VI	Estimation of Fe in cement	3	
VII	Synthesis of some transition metal complexes Potassium tris(oxalato)ferrate(III) Tris(acetylacetonato)manganese(III) Tris(acetylacetonato)iron(III) Oxobis(acetylacetonato)vanadium(IV) Nickel(II) bis(dimethylglyoximate)	15	Students will learn basics synthesis of transition metal complexes and characterization techniques

Course Outcome	Students will gain understanding and skill for quantitative analytical and synthetic techniques. They will also gain knowledge regarding different characterization techniques such as UV-Vis, IR etc.
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Learning Resources	1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Harris, D. C.; Lucy, C. A. (2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company
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5th Semester

Course Code	CH3101N	Course Name	Physical Chemistry-III	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
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Course Offering Department	Chemistry	Data Book / Codes/Standards	None
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Course Objectives	To introduce working principles of spectroscopy and use of group theory for fundamental understanding alongwith introducing the relevant descriptions of crystals.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	<p>Basic Spectroscopy Qualitative description of interaction of electromagnetic radiation with molecules; Transition between two states</p> <p>Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules</p> <p>Vibrational spectroscopy: Classical equation of vibration, anharmonicity, dissociation energies, degrees of freedom for polyatomic molecules, modes of vibration, Diatomic vibrating rotator, P, Q, R branches</p> <p>Electronic Spectroscopy: Frank-Condon principle and vibrational structure of electronic spectra; principle of determination of dissociation energy; Pre-dissociation; Rotational fine structure, Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; rule of mutual exclusion</p> <p>Nuclear Magnetic Resonance (NMR) spectroscopy: Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra</p>	28	Students will be introduced to the field of spectroscopy. They will learn about the general spectra obtained from molecules, including microwave, vibrational, Raman, and electronic spectra. The course will cover the basic principles of individual spectroscopic techniques, selection rules, and key spectral features such as the Franck–Condon principle, fine structure, chemical shifts, and spin–spin coupling.
II	<p>Molecular symmetry and groups/ Definitions and theorems of group, subgroup, class, Symmetry operations and symmetry elements, Point groups, physical properties: Polarity, Chirality</p>	14	Student will learn group theory and molecular symmetry and will learn to prepare character tables to study physical properties of

	etc., Matrix representations of symmetry operations, group multiplication, Properties of matrix representations: Similarity transforms, Characters of representations, Irreducible and reducible representations of group, the Great Orthogonality Theorem, Character tables and its use in IR and Raman spectroscopy.		molecules and spectroscopic transitions
III	Introduction to Solid State Classification of solid, Unit cell, Bravais lattice types, symmetry elements in crystals. Laws of crystallography, Law of constancy of interfacial angles, Law of rational indices, Miller indices for crystallographic planes, Calculation of interplanar spacing, Bragg's law of X-ray diffraction, Specific heat of solids, thermal compressibility of solids; Dulong –Petit's law	14	It will help students understand the detailed structure of solids, including crystal systems, concept of unit cells, symmetry, crystallographic planes

Course Outcome	<ol style="list-style-type: none"> 1. Students will understand the interaction of electromagnetic radiation with molecules 2. Students will be able to explain basis of rotational and vibrational spectroscopy, including selection rules, spectral features, and molecular structure determination 3. Students will get insights about electronic and Raman spectroscopy, including Franck–Condon principle, fine structure, and vibrational–rotational features 4. Students will be able to explain the basic principles of NMR spectroscopy 5. Students will understand molecular symmetry and group theory concepts and apply character tables to analyze physical properties and spectroscopic behavior of molecules 6. Students will learn the different forms of solids, interpret symmetry elements present in crystalline solids and the basics of crystal structure analysis
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Learning Resources	<ol style="list-style-type: none"> 1) Symmetry & Spectroscopy by D. C. Harris and M. D. Bertoluchi 2) Molecular Spectroscopy by C. N. Banwell 3) Molecular Spectroscopy by D. J. Hollas 4) Molecular Spectroscopy by I. Levine 5) Introduction of Molecular Spectroscopy by G. Barrow 6) Molecular Spectroscopy by J. D. Graybeal 7) Solid State Physics by A. J. Dekker 8) Introduction to Solids L. V. Azaroff 9) Solid State Chemistry: An Introduction by Smart & Moore
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	CH3102N				PC	L	T	P
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Course Code		Course Name	Inorganic Chemistry-II	Course Category		3	1	0
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Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To develop understanding of chemistry of main group elements
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	<p>Main Group Chemistry-I Groups- 1 and 2: Differentiate the properties of Li and Be from other members of their groups. Compare the properties of Hydrides, Nitrides, Carbides and Oxides of Gr – 1, Gr – 2. Lithium carbonate, basic beryllium acetate, Alkalides and Electride, Reverse sodium hydride. Isotopes of H, ortho and para- hydrogen.</p> <p>Group 17: Color of halogens in different media. Halogen hydrides, their acidity; describe preparation, properties, structures and bonding of the oxides and oxy acids.</p> <p>Group-18: Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation, properties and reactivities of fluorides (XeF_n) and oxofluorides (XeO_mF_n) of xenon. Describe xenon-oxygen compounds. Illustrate molecular shapes of noble gas compounds. Compare the nature of bonding in noble gas compounds. Xenon-oxygen compounds. Fluorides of krypton.</p>	14	Students will understand the chemistry of groups 1, 2, 17 and 18.
II	<p>Main Group Chemistry-II Group 13, 14, 15 and 16: Concepts and explanation of variation in catenation properties along the period and down the group; variation in formulations of oxides, oxoacids, halides in Groups 13,</p>	14	Students will understand the basic chemistry of groups 13, 14, 15 and 16.

	14, 15, 16 and 17; variation in structures and redox properties of hydrides, oxides and oxoacids. Inert Pair Effect and stability of Tl(I) and Pb(II).		
III	Main Group Chemistry- III Preparation, properties of boranes; Structure and bonding of diborane, Borazine, Boron nitrides; Structure and bonding of Phosphazene, phosphonitrilic compounds (PNCl ₂) _n ; Structure and bonding of sulfur nitrogen compounds (SN) _x ; Synthesis, structures and properties of (i) the inter-halogen compounds, (ii) polyhalides and pseudohalides including their preparations, properties and structures	14	Students will learn about compounds obtained from main group elements
IV	Structure of Inorganic Solids/13L Close packing model of spheres: ccp and hcp; Structure of inorganic solids (3D): CsCl derived structures: Cu ₂ O and Rutile; NaCl derived structures: FeS ₂ and CaC ₂ ; Zinc blende derived structures: β-cristobalite and Fluorite; hexagonal close packed derived structures: WC and Wurtzite; Structure of Perovskite and Spinel; Structure of two dimensional Inorganic solids: CdCl ₂ and Brucite [Mg(OH) ₂]; Structure of one dimensional Inorganic Solids: BeCl ₂ and CuCl ₂ .	14	Students will learn the structures of inorganic solids

Course Outcome	Students will gain knowledge 1. basic chemistry of main group elements 2. basics structural features for some inorganic solids
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Learning Resources	<ol style="list-style-type: none"> 1. Cotton, F. A., Wilkinson, G., and Gaus, P. L., <i>Basic Inorganic Chemistry</i>, 3rd Ed., Wiley India. 2. Shriver, D. F. and Atkins, P., <i>Inorganic Chemistry</i>, 5th Ed., Oxford University Press. 3. Huheey, J. E., Keiter, E. A., and Keiter, R. L., <i>Inorganic Chemistry: Principles of Structure and Reactivity</i>, 4th Ed., Harper Collins, 1993, Pearson. 4. Douglas, B. E. and McDaniel, D. H., <i>Concepts & Models of Inorganic Chemistry</i>, Oxford, 1970. 5. Sharpe, A. G., <i>Inorganic Chemistry</i>, 4th Indian Reprint, Pearson Education. 6. Housecroft, C. E. and Sharpe, A. G., <i>Inorganic Chemistry</i>, 5th Edition, Pearson. 7. Wulfsberg, G., <i>Inorganic Chemistry</i>, Viva Books Private Limited. 8. N. N. Greenwood, A. Earnshaw, <i>Chemistry of the Elements</i>, 2nd Edition, 199 9. Concise Inorganic Chemistry, 5th Edition, J. D. Lee
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Course Code	CH3103N	Course Name	Advanced Topics in Chemistry-I	Course Category	PC	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	<p>1. To gain basic ideas about nanoscience and nanotechnology.</p> <p>3. To equip students with the knowledge and problem-solving skills needed to plan and execute complex organic syntheses using Organometallic reagents. Organometallic reagents are compounds that contain at least one carbon-metal bond. Due to the significant difference in electronegativity between carbon and most metals, this bond is highly polar, making the carbon atom act as a strong nucleophile or a potent base.</p> <p>4. Retrosynthetic analysis is a systematic problem-solving technique for planning organic syntheses. It involves working backward from the target molecule (the desired product) to progressively simpler, commercially available starting materials. Organometallic reagents focus on understanding the synthesis, structure, reactivity, and applications of these compounds, particularly in homogeneous catalysis.</p>
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	<p>Introduction to Nanoscience Definition and importance of Nano, different properties and size effect, nanoaggregates. Evolution of band structure, concepts of the conduction and valence bands, Quasi Fermi levels, Brillouin zone, energy spectrum of electrons in a crystal, occupation of bands by electrons, quantum confinement, excitons, phonons. Concepts of quantum dots. Basic approaches of synthesis nanomaterials, Bottom up and top down processes, fundamental of sol – gel process, characterization of nanomaterials by different techniques, carbon nanotubes and their classification.</p>	14	Students gain knowledge about the properties and synthesis of nanomaterials, and their applications in Nanoscience and Nanotechnology.
II	<p>Organometallic reagents and Retrosynthetic analysis <i>Organometallic reagents:</i> Preparation, structure, and reactivity of Grignard reagents, Organolithium compounds,</p>	14	Students can learn the preparation, structure, and reactivity of key organometallic reagents including Grignard reagents, organolithium

	<p>and Organocopper compounds, Shapiro reaction</p> <p><i>Retrosynthetic analysis:</i> Disconnections; synthons, donor and acceptor synthons; natural reactivity and umpolung; latent polarity in bifunctional compounds: consonant and dissonant polarity; illogical electrophiles and nucleophiles; synthetic equivalents; functional group interconversion and addition (FGI and FGA); Synthetic methodology EAA, ECA, DEM, AA approach, Acylation of olefins, α-alkylation of ketone, Strategy of ring synthesis</p>		<p>compounds, and organocopper compounds, with appropriate reaction mechanisms.</p> <p>The retrosynthetic analysis via disconnection approach will be introduced to the students.</p>
III	<p>Chemical Kinetics</p> <p>Determination of order of a reaction by half-life and differential method; Opposing reactions, parallel reactions and consecutive reactions (with explanation of kinetic and thermodynamic control of products; all steps first order) ; Rate equation for the fast reaction, Arrhenius equation, energy of activation; Free energy profiles for one step and multistep reactions, Collision theory of reaction rates, Lindemann mechanism, Basics of conventional Transition state theory.</p> <p>Homogeneous catalysis with reference to acid-base catalysis; Primary kinetic salt effect; Enzyme catalysis; Michaelis-Menten equation, Lineweaver Burk plot, Autocatalysis; periodic reactions.</p>	14	<p>Students will be introduced to post-highschool concepts of chemical kinetics that are relevant in a wide range of fields. Students will learn to quantify experimental findings and learn to express the same with certain mathematical expressions.</p>

Course Outcome	<ol style="list-style-type: none"> Students will be able to understand the importance of metals in life, the structures and functions of a variety of metalloenzymes, and will be able to apply the principles of coordination chemistry in biological systems. Students will be able to learn the preparation, structure, and reactivity of important organometallic reagents, including Grignard reagents, organolithium compounds, and organocopper compounds, along with their corresponding reaction mechanisms. The principles of retrosynthetic analysis using the disconnection approach will also be learnt. Students will be equipped with basics of chemical kinetics that are prerequisite for any field of chemistry or chemical engineering.
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Learning Resources	<ol style="list-style-type: none"> Nanostructures and Nanomaterials- G. Cao, Y. Wang Nanoscale materials in chemistry-Kenneth J Klabunde, Ryan M Richards Introduction to Nanoscience and Nanotechnology by Chattopadhyay K. K and A. N. Banerjee Principles of Nanoscience and Nanotechnology by M. A. Shah and T. Ahmad.
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<p>5. A Textbook of Nanoscience and Nanotechnology Hardcover – 2012 by T. Pradeep</p> <p>6. Fundamentals of Nanoscience Unknown Binding – 2017 by S L Kakani</p> <p>7. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.</p> <p>8. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</p> <p>9. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.</p> <p>10. Carey, F. A., Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.</p> <p>11. Organometallic Chemistry – R.C. Mehrotra & A. Singh</p> <p>12. Organic Synthesis – The Disconnection Approach – S. Warren</p> <p>13. Organometallic Chemistry – L.S. Hegedus</p>
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Course Code	CH3171N	Course Name	Physical Practical– II	Course Category	PC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To provide hands on experience on several electrochemistry and kinetics experiment and teaching them use of certain advanced instruments
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Conductometric titration of a mixture of Hydrochloric acid, potassium chloride & ammonium chloride with silver nitrate and sodium hydroxide.	6	Perform conductometric titrations and analyze mixtures of acids and salts. Verify the Onsager equation and determine limiting molar conductance of strong electrolytes. Conduct potentiometric titrations to determine halide concentrations. Study reaction kinetics, including hydrolysis and redox reactions, and investigate solvent effects. Verify adsorption isotherms and determine
II	Verification of Onsager equation and thereby to find out the value of λ_0 of a strong electrolyte.	6	
III	Potentiometric determination of the strength of chloride, bromide & iodide by titration with silver nitrate.	6	
IV	Kinetic study of hydrolysis of crystal violet in alkali solution and solvent effect with acetone.	6	
V	Verification of Freundlich Adsorption Isotherm for adsorption of acetic acid on activated charcoal.	6	

VI	Determination of solubility product with and without common ion effect.	6	solubility products with and without the common ion effect.
VII	Study of kinetics of $K_2S_2O_8 + KI$ reaction, spectrophotometrically	6	

Course Outcome	<ol style="list-style-type: none"> Students will acquire practical skills in conductometry, potentiometry, kinetics, adsorption, and solubility experiments Students will analyze and interpret experimental data to study electrolyte behavior, reaction rates, and equilibrium phenomena
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Learning Resources	<ol style="list-style-type: none"> Practical Physical Chemistry by Levitt, B. P. edited Findlay's Practical Physical Chemistry Longman Group Ltd. Advanced Practical Physical Chemistry by Athawale and Mathur Practical Physical Chemistry Viva Books (2009) by Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry by Palit, S.R., De, S. K.
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Minor For Other Departments

Course Code	CH3161N	Course Name	General Chemistry	Course Category	PM	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	This course aims to:(i) Introduce basic and essential concepts of thermodynamics and demonstrate a relationship with kinetic theory. (ii) Elucidate the thermodynamical laws and their usefulness to various thermal systems and phase transitions. (iii) Students will gain an understanding of the structure, properties, and reactions of carbon-based compounds, forming a foundation for the study of fundamental principles such as bonding, functional groups, stereochemistry, and reaction mechanisms.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Periodic Properties Modern IUPAC Periodic table, atomic radii, ionic radii, covalent radii, ionization energy, electron affinity and electronegativity, Group trends and periodic trends in these properties in respect of <i>s</i> -, <i>p</i> - and <i>d</i> -block elements,	14	Students develop the ability to systematically analyze, predict, and rationalize periodic trends.

	Electronegativity scales (Pauling's, Mulliken's and Allred-Rochow's scales), scandide contraction, lanthanide contraction, Secondary periodicity, Relativistic Effect, Inert pair effect.		
II	<p>Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Resonance and Hyperconjugation, Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape, and reactivity of organic molecules, Nucleophiles and electrophiles, Reactive Intermediates: Carbocations, Carbanions, and Free Radicals, Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule</p> <p>Stereochemistry: Illustrate different types of isomerism; geometrical and optical isomerism; Describe the concept of chirality and optical activity (up to two carbon atoms); define asymmetric carbon atom and elements of symmetry; Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations; Define and illustrate enantiomerism and diastereomerism, meso compounds; <i>threo</i> and <i>erythro</i>, D and L, <i>cis</i> and <i>trans</i> nomenclature; CIP Rules: <i>R/S</i> (upto 2 chiral carbon atoms) and <i>E/Z</i> nomenclature(for up to two C=C systems).</p>	14	Focusing on understanding organic structure, bonding (hybridization, resonance), nomenclature, functional groups, acid-base properties, reaction mechanisms (substitution, addition, elimination), stereochemistry, recognizing stereoisomers and nomenclatures of 3D shapes for organic molecules.
III	<p>Classical Thermodynamics Carnot Engine, Second, law of thermodynamics, Third Law of Thermodynamics, entropy change accompanying various processes, Gibbs energy, Gibbs Helmholtz equation, Chemical potential, Criteria of spontaneity, Applications of thermodynamics in phase equilibrium (one- and two-component systems), Clapeyron and Clausius-Clapeyron equations.</p>	14	Classical thermodynamics course will apply the basic laws of thermodynamics, concepts of entropy, Gibbs free energy and ideas related to thermodynamic processes.

Course Outcome	Apply knowledge of organic chemistry and stereochemistry to predict the properties, reactivities, mechanism, intermediates and synthesis design. Students will gain a foundational understanding of key concepts in classical thermodynamics. This knowledge will prepare them for advanced studies and equip
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	them with the theoretical and analytical skills needed for careers in research, pharmaceuticals, materials science, chemical engineering and biotechnology.
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Learning Resources	<ol style="list-style-type: none"> 1. Physical Chemistry by G. W. Castellan 2. Atkins' Physical Chemistry by P. Atkins and J. de Paula 3. Heat and Thermodynamics by M. W. Zemansky and R. H. Dittman 4. Basic Chemical Thermodynamics by E. B. Smith 5. The Principles of Chemical Equilibrium by K.G. Denbigh 6. Molecular Thermodynamics by D. A. McQuarrie and J. D. Simon 7. Thermodynamics for Chemists by S. Glasstone 8. Chemical Thermodynamics by I. M. Klotz and R. M. Rosenberg 9. Organic Chemistry, Clayden, N. Greeves, S. Warren and P. Wothers, (Oxford University Press) 10. Principle of organic synthesis -R.O.C. Norman & J. M. Coxon. 11. Advanced Organic Chemistry – Jerry March 12. Stereochemistry of Organic Compound – D. Nosipuri 13. Stereochemistry of Carbon Compound – E.L. Eliel
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Course Code	CH3162N	Course Name	Basic Organic Reactions: Aliphatic and Aromatic	Course Category	PM	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	<ol style="list-style-type: none"> 1. To focus on structure of Organic Aliphatic and Aromatic Compounds, properties, nomenclature, and key reactions understanding of reaction types, mechanisms, and how the structure of a molecule dictates its reactivity for organic moieties. 2. To understand the role of appropriate reagents and conditions for specific transformations.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Nucleophilic Substitution and Elimination Reactions: Describe nucleophilic substitutions: define S _N 1 and S _N 2 reactions; define eliminations: E ₁ and E ₂ reactions (elementary	7	The fundamentals of substitution and elimination reactions will be discussed. Students will

	mechanistic aspects); explain Saytzeff and Hofmann eliminations; illustrate the competitive pathways elimination vs substitution.		learn Saytzeff and Hoffman elimination mechanisms.
II	Chemistry of Aromatic Hydrocarbons: Aromatic electrophilic substitution reactions (nitration, sulfonation, halogenation, Friedel-Crafts reaction, with their mechanisms), illustrate side-chain oxidation of alkyl benzenes (up to 4 carbons on benzene). Describe Preparation: (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. Reactions (Chlorobenzene): nucleophilic aromatic substitution (replacement by -OH group) and effect of nitro substituent (activated nucleophilic substitution), Reimer-Tiemann reaction	14	Students will be introduced to the chemistry of aromatic hydrocarbons. Side chain oxidation, electrophilic substitution reaction and functionalization of benzene rings will be discussed.
III	Chemistry of Carbonyl Compounds: Define carbonyl compounds. Describe their preparation from acid chlorides, and nitriles; discuss the reactions of Grignard reagents with carbonyls (formaldehyde, acetaldehyde, acetone, benzaldehyde, etc.). Interpret general properties of aldehydes and ketones, such as reaction with HCN, ROH, NaHSO ₃ , NH ₂ -G derivatives, and with Tollens' and Fehling's reagents. Illustrate iodoform test, aldol condensation (with mechanism), Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation, Clemmensen reduction, Wolff-Kishner reduction and Meerwein-Ponndorff-Verley (MPV) reduction	14	Students will gain knowledge about the chemistry of carbonyl compounds. Structure-reactivity relationship and various reactions characteristics of carbonyl functional group will be discussed in detail.
IV	Chemistry of Carboxylic Acid and Derivatives: Review the methods of preparation by acidic and alkaline hydrolysis of esters (B _{AC} ² and A _{AC} ² mechanisms only) and from Grignard reagents. Interpret Reformatsky reaction, Hell-Vohlard-Zelinsky reaction, Claisen condensation, and Perkin reaction. Describe the preparation and reactions of carboxylic acids, acid chlorides, anhydrides, esters, and amides.	7	Students gain concept of structure, properties, synthesis, and a wide array of reactions of carboxylic acids and their derivatives.

Course Outcome	<p>1. Understanding reaction mechanisms provides fundamental insights into chemical processes, enabling chemists to predict the final products, comprehend reaction behavior (kinetics and thermodynamics), and control or optimize reactions.</p> <p>2. Significant outcomes include understanding structure, properties, synthesis, and a wide array of reactions of organic molecules containing aromatic moieties, carbonyl and carboxylic acid as functional groups, their unique reactivity (electrophilic aromatic substitution and nucleophilic addition), the ability to synthesize various functional groups like alcohols, and their fundamental roles in biological processes and industrial applications.</p>
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Learning Resources	<p>1. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.</p> <p>2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</p> <p>3. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.</p> <p>4. Carey, F. A., Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.</p> <p>5. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.</p> <p>6. Organic Chemistry, Volume 1, I L Finar</p> <p>7. Advance Organic Chemistry: Reaction Mechanisms - B. Reinhard</p> <p>8. Mechanisms and Theory in Organic Chemistry - T. H. Lowry and K. H. Richardson</p>
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Course Code	CH3172N	Course Name	Chemistry Laboratory-I	Course Category	PM	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To provide the students with a practical experience of the various techniques used in chemistry. The students will be trained both quantitatively and qualitatively during the practical work so that their understanding and problem-solving abilities can be enhanced.
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Module	Syllabus	Duration (class-hour)	Module Outcome
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I	Preparation of primary standard solutions and Determination of Fe ³⁺ in the supplied solution	3	Students will learn to apply basic techniques used in the chemistry laboratory and will be to estimate the ions/metal ions, partition coefficient, and organic functional groups. Students will also learn basic safety rules in the laboratory
II	Estimation of Cu ²⁺ in the supplied solution	3	
III	Estimation of hardness in water by the EDTA method	3	
IV	Determination of the partition coefficient of benzoic acid in toluene and water	6	
V	Detection of nitrogenous and non-nitrogenous functional groups in known and unknown organic compounds	21	
VI	Determination of solubility product with and without common ion effect	6	

Course Outcome	To learn and apply basic techniques used in the chemistry laboratory. To be able to estimate the ions/metal ions. To learn safety rules in the practice of laboratory investigations.
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Learning Resources	<ol style="list-style-type: none"> G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, "Vogel's Text Book of Quantitative Chemical Analysis" O.P. Vermani & Narula, "Theory and Practice in Applied Chemistry", New Age International Publishers. <p>Gary D. Christian, "Analytical chemistry", 6th Edition, Wiley India.</p>
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6th Semester

Course Code	CH3201N	Course Name	Organic Chemistry- III	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	The course objectives for Heterocyclic Chemistry, Carbohydrate, Pericyclic Reaction, and Stereochemistry of cyclohexane modules in an organic chemistry curriculum generally focus on understanding the structure, properties, reactivity, synthesis, and real-world applications of these compound classes.
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Module	Syllabus	Duration (class-hour)	Module Outcome
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I	Heterocyclic Chemistry I: Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions, and mechanism of substitution reactions of: Furans, Pyrroles, Thiophenes, Pyridines, Indoles, Quinolines, and Isoquinolines	14	Students will learn the nomenclature of the heterocyclic compounds with one hetero atom. Synthesis and substitution reaction of common heterocyclic structure will be explained.
II	Carbohydrate Chemistry I: Occurrence, classification, and their biological importance; Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides—Structure elucidation of maltose, lactose, and sucrose	14	Students will understand the basics of carbohydrate chemistry especially the Structure, Isomerism, Key Linkages and Bonds, and Biological Roles of carbohydrate molecules.
III	Pericyclic Reaction I: <i>Electrocyclic reactions</i> : FMO approach involving 4π - and 6π -electrons (thermal and photochemical) and corresponding cycloreversion reactions. <i>Cycloaddition reactions</i> : FMO approach, Diels-Alder reaction, Effect of Lewis acids, solvent, and templated in DA reaction	14	In this module, the students will come to know the fundamentals of the pericyclic reactions. The FMO approach of the thermally and photochemically induced cycloaddition reactions will be discussed.
IV	Stereochemistry III: Cycloalkanes, Nomenclature, types of strain, Bayer strain theory, measurement of strain and classification of ring sizes, consequences of strain in small, normal, medium, and large ring, conformation analysis of cyclohexanes, effect of substitution on ring conformation of cyclohexane, conformation of cyclohexene, Halo ketone effect, ring synthesis- principles controlling ring closure reactions, rules for ring closure (Baldwin's rule), ring expansion and contraction processes, polycyclic system-Bredt's rule	14	The module is designed to introduce the stereochemistry of cyclohexane, the strain in small, medium, normal and large rings, halo-ketone effect, Baldwin's rule, Bredt's rule.

Course Outcome	A course covering heterocyclic chemistry, carbohydrates, pericyclic reactions, and the stereochemistry of cyclohexane aims to provide students with a deep understanding of the structure, reactivity, and biological significance of these important organic molecules and reaction types.
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Learning Resources	<ol style="list-style-type: none"> 1. Heterocyclic Chemistry – J.A. Joule & K. Mills. 2. Heterocyclic Chemistry – J.A. Joule & G.F. Smith 3. Topics in Heterocycles Chemistry. G. W. Gribble. 4. Carbohydrate Chemistry – S. Khadem 5. Organic Chemistry – I.L. Finar (Vol.II) 6. Natural Products: Chemistry & Biological Significance - J. Mann, R.S. Davidson et. al. 7. Pericyclic Reaction Vols. I & II - R.E. – Lehr & A. P. Marchand. 8. Pericyclic Reaction – S.M. Mukherjee 9. Frontier Orbitals and Organic Chemical Reactions, I. Fleming, (Wiley).. 10. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994. 11. Stereochemistry of Organic Compound – D. Nosipuri 12. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001
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Course Code	CH3202N	Course Name	Inorganic Chemistry-III	Course Category	PC	L	T	P
						3	1	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To learn and understand the nature of bonding, spectral aspects and magnetic properties of transition metal complexes and their applications. The aim of the course organometallic chemistry is to expose students to different types of organometallic compounds, their structure-bonding correlation and their importance as crucial intermediates during different chemical transformations, catalysis in particular. The course on catalysis deals with different catalytic reactions of industrial importance. This course primarily focused on the fundamental chemistry of different industrial catalytic reactions. It aims to teach students how using our text-book knowledge, new catalysts may be designed and synthesized for targeted chemical transformations in a sustainable manner.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Coordination Chemistry Recapitulations of Werner's theory – describe the concept of primary and secondary valency, Classify the types of ligands, IUPAC nomenclature, Isomerism (constitutional and stereo isomerism, Geometrical and optical isomerism in square planar and octahedral complexes)	21	Understanding the bonding in transition metal complexes and applying the concept of chemical bonding in metal complexes to understand the spectral properties

	<p>VB description and its limitations. Elementary Crystal Field Theory: splitting of d^n configurations in octahedral, square planar and tetrahedral fields, concept of highspin, low-spin, and spin state crossover in transition metal complexes; crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy. Spectrochemical series. Jahn- Teller distortion. Octahedral site stabilization energy (OSSE). Highlight the manifestation of CFSE. Application of CFSE for various chemical and physical properties. Discuss limitations of the crystal field model; evidence in favor of metal-ligand bonding. Illustrate Nephelauxetic effects. Concept of Ligand Field Theory: Metal-ligand bonding (MO concept, elementary idea), sigma- and pi-bonding in octahedral complexes (qualitative pictorial approach) and their effects on the oxidation states of transitional metals (examples).</p>		
II	<p>Organometallic and Catalysis -I Definition and classification of organometallic compounds on the basis of bond type; Concept of hapticity of organic ligands. Concept of Effective Atomic Number (EAN) and EAN rule for stability of complexes; concept of 18-electron and 16-electron rules and their applications to organometallic complexes; General methods of preparation of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls. pi-acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back bonding. Chemistry of metal nitrosyls: synthesis, structure and stereo chemical control of valence; Zeise salt: synthesis, structure, and bonding; metallocene: synthesis, structure and reactivity of ferrocene; Fluxionality in organometallic complexes</p>	21	<p>Providing exposure of different organometallic compounds, their structure-bonding correlation, reactivity and their importance as key intermediates in different chemical transformations.</p>
III	<p>Basic Chemistry of d and f block elements Transition Elements: Outline a general comparison of 3d, 4d and 5d elements in terms of electronic</p>	14	<p>Learn the general trends in the d and f-block metals/ metal ions.</p>

	<p>configuration, relativistic effect, oxidation states, redox properties; coordination chemistry of various oxidation states.</p> <p>Interpret the chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states. Preparation, structure and properties of some selected compounds: $K_3[Fe(CN)_6]$, $K_4[Fe(CN)_6]$, Prussian blue, Creutz-Taube complex, Magnus Green salt. Concepts of inorganic clusters, cages and cubane.</p> <p>Lanthanoids and Actinoids: Review electronic configuration, oxidation states, colour and spectral properties, lanthanide contraction.</p>			
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Course Outcome	<p>To understand</p> <ol style="list-style-type: none"> 1. the basic bonding principles in coordination complexes. 2. basic idea of the spectra and magnetism in the complexes 3. organometallic complexes 4. d and f-block chemistry
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Learning Resources	<ol style="list-style-type: none"> 1. Cotton, F. A., Wilkinson, G., and Gaus, P. L., <i>Basic Inorganic Chemistry</i>, 3rd Ed., Wiley India. 2. Shriver, D. F. and Atkins, P., <i>Inorganic Chemistry</i>, 5th Ed., Oxford University Press. 3. Huheey, J. E., Keiter, E. A., and Keiter, R. L., <i>Inorganic Chemistry: Principles of Structure and Reactivity</i>, 4th Ed., Harper Collins, 1993, Pearson. 4. Douglas, B. E. and McDaniel, D. H., <i>Concepts & Models of Inorganic Chemistry</i>, Oxford, 1970. 5. Sharpe, A. G., <i>Inorganic Chemistry</i>, 4th Indian Reprint, Pearson Education. 6. Housecroft, C. E. and Sharpe, A. G., <i>Inorganic Chemistry</i>, 5th Edition, Pearson. 7. Wulfsberg, G., <i>Inorganic Chemistry</i>, Viva Books Private Limited. 8. N. N. Greenwood, A. Earnshaw, <i>Chemistry of the Elements</i>, 2nd Edition, 1997 9. Concise Inorganic Chemistry, 5th Edition, J. D. Lee 10. Organometallic Chemistry – R.C. Mehrotra and A. Singh 11. Organometallic Chemistry – R.H. Crabtree 12. Organometallic Chemistry – M. Bochmann (Oxford series)
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Course Code	CH3203N	Course Name	Advanced Topics in Chemistry-II	Course Category	PC	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
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Course Offering Department	Chemistry	Data Book / Codes/Standards	None
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Course Objectives	<ol style="list-style-type: none"> 1. The learners should be able to learn and identify active site structure and functions of some transition metal ions containing metalloproteins or enzymes. 2. To apply spectroscopic techniques for organic compounds 3. To gain idea about data and error analysis
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	<p>Bioinorganic Chemistry-1 Elements of life, the natural selection of elements, metallo-biomolecules–enzymes and proteins, their differences, homeostatis and detoxification, Metal ion storage and transport: Ferritin, metallothioneins, ceruloplasmin, Vanadium storage in tunicates and ascidians; Siderophores – enterobactin, transferrin; Natural Oxygen carriers: Hemoglobin, Hemocyanin, Hemerythrin– model compounds. Hydrolytic enzyme: Carboxypeptidase A, Redox enzyme: Blue Copper protein.</p>	14	The learners should be able to learn and identify active site structure and functions of some essential transition metal ions containing metalloproteins or enzymes.
II	<p>Application of spectroscopy in organic chemistry <i>UV-Vis Spectroscopy:</i> Fundamental principles, Types of electronic transitions; Interpretation of UV-Vis spectra of organic compounds Chromophores, Auxochromes, Bathochromic and Hypsochromic shifts, Hyper-/Hypochromic effects, Intensity of absorption; Application of Woodward Rules for calculation of λ_{max} of α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers. <i>IR Spectroscopy:</i> Fundamental principles of molecular vibrations; describe the application of Hooke's law,</p>	14	Focus on interpreting spectra to determine a compound's structure, functional groups, and concentration, as well as understanding the underlying principles and practical applications of each technique.

	<p>Interpretation of IR spectra of organic compounds, Analyse the characteristic and diagnostic stretching frequencies of C-H, N-H, O-H, C-O, C-N, C-X, C=C (including skeletal vibrations of aromatic compounds), C=O, C=N, N=O, C≡C, C≡N. Describe the factors affecting stretching frequencies, such as the effect of conjugation, electronic effects, mass effect, bond multiplicity, ring-size, solvent effect, and H-bonding on IR absorptions. Fingerprint region and group frequency regions; application in functional group analysis.</p> <p>¹H NMR Spectroscopy: Nuclear spin; NMR active molecules; Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; Spin-Spin coupling and coupling constant (1st order spectra); Pascal's triangle, Anisotropic effects in alkene, alkyne, aldehydes and aromatics, NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds (both aliphatic and aromatic).</p>		
III	<p>Data and error analysis Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution, Gaussian Distribution and Errors in measurement and their effect on data sets. Indeterminate errors, statistical test of data; F, Q and T test, rejection of data, and confidence intervals. Descriptive statics using excel.</p>	14	The module generally equips students with the skills to collect, process, analyse, visualise, and interpret chemical data using statistical methods and software tools.

Course Outcome	<p>Students will be able to understand the importance of metals in life, the structures and functions of a variety of metalloenzymes, and will be able to apply the principles of coordination chemistry in biological systems. Students will develop fundamental scientific understanding and practical, interdisciplinary skills that explain how matter behaves from the atomic scale to real-world applications. Students will further gain proficiency in applying computational and statistical methods to chemical data, moving from basic error analysis to advanced machine learning for problem-solving in research and industry.</p>
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Learning Resources	<ol style="list-style-type: none"> 1) Bioinorganic Chemistry – I. Bertini, H.B. Gray, S.J. Lippard, J.S. Valentine. 2) Bioinorganic Chemistry – S.J. Lippard and J.M. Berg 3) Bioinorganic Chemistry – W. Kaim & G. Schroedder 4) Inorganic Biochemistry– J. A. Cowan 5) Data Analysis for Chemistry By D B. Hibbert and J. J. Gooding 6. W. Kemp, Organic Spectroscopy, 3rd Edition, Macmillan, 2019 7. D. L. Pavia, G. M. Lampman, G. S. Kriz, J. A. Vyvyan, Introduction to Spectroscopy, 5th Edition, Cengage Learning, 2013. 8. C. N. Banwell, and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw-Hill, 1962 9. Spectrometric Identification of Organic Compounds – R. M. Silverstein, G. C. Bassler and T. C. Morrill 10. Organic Spectroscopic Analysis – R.J. Anderson, D.J. Bendelm & P.W. Groundwater
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Course Code	CH3271N	Course Name	Organic Practical– II	Course Category	PC	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	<ol style="list-style-type: none"> 1. To quantify specific organic compounds like glucose, sucrose, aromatic amines, phenol, and acetic acid using titration and bromination methods. 2. Estimation analysis renders students to understand the efficiency of chemical reactions and isolation procedures by determining the final yield of the desired product. 3. Important organic reactions" includes the specific organic synthesis to provide students with a practical and theoretical understanding of key organic reactions and modern analytical techniques.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Organic quantitative analysis: (i) Determine the amount of glucose and/or sucrose by titration using Fehling's solution (ii) Determine the amount of aromatic amine (aniline)/ phenol by bromination (bromate-bromide) method. (iii) Determine the amount of acetic acid in commercial vinegar	18	1. The listed organic quantitative analysis methods relate to quality control, nutritional labeling, and diagnostic testing.

II	<p>Important organic reactions: Preparation of Coumarin, Aldol condensation using either a conventional or a green method. Benzil-Benzilic acid rearrangement, Reduction of <i>p</i>-nitrobenzaldehyde by sodium borohydride, Hydrolysis of amides and esters.</p> <p>Identification of simple organic compounds by IR and NMR spectroscopy. (Spectra of some simple molecules to be provided).</p>	24	2. The mentioned reactions and techniques are extensive, primarily focusing on synthesis of valuable compounds, carbon-carbon bond formation for complex molecules, and evaluating the efficiency of chemical reactions and isolation procedures by obtaining the final yield of the desired product.
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Course Outcome	<p>Students gain knowledge through the practical course of the following:</p> <p>Analytical Skill development: to estimate the precise amount or percentage composition of specific elements, functional groups, or compounds within a given organic sample.</p> <p>Quality Control: Used extensively in manufacturing to confirm the structure and purity of raw materials, intermediates, and final products in the pharmaceutical, petrochemical, and polymer industries.</p> <p>Research & Development: Fundamental for identifying and characterizing novel organic compounds during synthesis, aiding in the development of new drugs, materials, and agrochemicals.</p> <p>Forensics and Environmental Analysis: Used to identify unknown substances, pollutants, and forensic evidence.</p>
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Learning Resources	<ol style="list-style-type: none"> 1. Vogel's Text Book of Practical Organic Chemistry – A.R. Tatchell 2. Introduction to Organic Laboratory technique – Pavia, Lampman, Kriz & Engel 3. Organic Experiments – K.L. Williamson 4. General Chemistry Experiments – A.J. Elias 5. Comprehensive Practical Organic Chemistry – V.K. Ahluwalia & R Agarwal
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Minor for Other Departments

Course Code	CH3261N	Course Name	General Inorganic Chemistry	Course Category	PM	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	To learn and understand the nature of bonding, spectral aspects and magnetic properties of transition metal complexes and their applications. The aim of the course organometallic chemistry is to expose students to different types of organometallic compounds, their structure-bonding correlation and their importance as crucial intermediates during different chemical transformations, catalysis in particular.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	<p>Coordination Chemistry Werner's theory – describe the concept of primary and secondary valency, Classify the types of ligands, IUPAC nomenclature, Isomerism (constitutional and stereo isomerism, Geometrical and optical isomerism in square planar and octahedral complexes) VB description and its limitations. Elementary Crystal Field Theory: splitting of d^n configurations in octahedral, square planar and tetrahedral fields, concept of highspin, low-spin, and spin state crossover in transition metal complexes; crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy. Spectrochemical series. Jahn- Teller distortion. Octahedral site stabilization energy (OSSE).</p>	14	Understanding the bonding in transition metal complexes and applying the concept of chemical bonding in metal complexes to understand the spectral properties
II	<p>Organometallic and Catalysis Definition and classification of organometallic compounds on the basis of bond type; Concept of hapticity of organic ligands. Concept of Effective Atomic Number (EAN) and EAN rule for stability of complexes; concept of 18-electron and 16-electron rules and their applications to organometallic complexes; Organometallic complexes and concept of Homogeneous Catalysis, hydroformylation, Wilkinson catalysis, Ziegler-Natta catalysis</p>	14	Providing exposure of different organometallic compounds, their structure-bonding correlation, reactivity and their importance as key intermediates in different chemical transformations.
III	<p>Basic principle of redox reactions Elementary idea of standard redox potentials, Nernst equation with derivation, concept of formal potential, influence of complex formation, precipitation and change of pH on redox potentials, redox titration, redox potential at the equivalence point, choice of redox indicator, Redox potential</p>	14	Students develop a conceptual understanding of redox processes.

	diagram (Latimer, Frost and Pourbaix diagrams) and applications, Disproportionation and comproportionation reactions.		
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Course Outcome	<ol style="list-style-type: none"> 1. To understand the basic bonding principles in coordination complexes and the spectra and magnetism in the complexes 2. Providing exposure of different organometallic compounds, their structure-bonding correlation, reactivity and their importance as key intermediates in different chemical transformations. 3. Catalysis part of the course enables students to think independently how new efficient catalysts may be designed and synthesized for targeted chemical transformations in a sustainable manner.
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Learning Resources	<ol style="list-style-type: none"> 1. Cotton, F. A., Wilkinson, G., and Gaus, P. L., <i>Basic Inorganic Chemistry</i>, 3rd Ed., Wiley India. 2. Shriver, D. F. and Atkins, P., <i>Inorganic Chemistry</i>, 5th Ed., Oxford University Press. 3. Huheey, J. E., Keiter, E. A., and Keiter, R. L., <i>Inorganic Chemistry: Principles of Structure and Reactivity</i>, 4th Ed., Harper Collins, 1993, Pearson. 4. Douglas, B. E. and McDaniel, D. H., <i>Concepts & Models of Inorganic Chemistry</i>, Oxford, 1970. 5. Sharpe, A. G., <i>Inorganic Chemistry</i>, 4th Indian Reprint, Pearson Education. 6. Housecroft, C. E. and Sharpe, A. G., <i>Inorganic Chemistry</i>, 5th Edition, Pearson. 7. Wulfsberg, G., <i>Inorganic Chemistry</i>, Viva Books Private Limited.
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Course Code	CH3262N	Course Name	General Physical Chemistry	Course Category	PM	L	T	P
						3	0	0

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry		Data Book / Codes/Standards	None	

Course Objectives	To provide introductory knowledge on kinetic theory of gasses, chemical kinetics and electrochemistry
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Kinetic Theory of gases Interpretation of pressure, temperature, and energy from kinetic theory, Nature of distribution of molecular velocity and	14	Students will understand molecular motion, energy distribution, and heat capacity of gases from

	<p>speed in one, two and three dimensions. The Maxwell-Boltzmann distribution of molecular speeds. Significance and application of the Maxwell-Boltzmann distribution such as fraction having at least a critical energy etc, Principle of equipartition of energy. Molecular basis of heat capacity of gases. Temperature variation of heat capacity. Collision of gas molecules-collision diameter and collision frequency. Mean free path.</p> <p>Deviation from ideal behavior in gas and real-gas equation of state, Law of corresponding state, Virial equation of state, van der Waals' form of the second virial coefficient and the significance of the second virial coefficient. Fugacity, fugacity coefficient. Choice of standard states of real gases Principle of estimation of fugacity.</p>		<p>kinetic theory. The module also explains real-gas behavior using equations of state, virial coefficients, and fugacity.</p>
II	<p>Chemical Kinetics Determination of order of a reaction by half-life and differential method; Opposing reactions, parallel reactions and consecutive reactions (with explanation of kinetic and thermodynamic control of products; all steps first order) ; Rate equation for the fast reaction, Arrhenius equation, energy of activation; Free energy profiles for one step and multistep reactions, Collision theory of reaction rates, Lindemann mechanism, Transition state theory.</p> <p>Homogeneous catalysis with reference to acid-base catalysis; Primary kinetic salt effect; Enzyme catalysis; Michaelis-Menten equation, Lineweaver Burk plot, Autocatalysis; periodic reactions.</p>	14	<p>To learn how to apply chemical kinetics to determine reaction order, mechanisms, energy profiles, catalysis, enzyme kinetics, and rate theories governing homogeneous reactions systems.</p>
III	<p>Electrochemistry Conduction in solution, Electromotive force, Different type of electrodes, Nernst equation, Relationship between thermodynamic properties and EMF of a cell, Battery, Fuel cell, Photovoltaic cell, Corrosion, Corrosion Control.</p>	14	<p>Students will understand and apply fundamental electrochemical concepts governing charge transport, energy conversion, material degradation, and their practical technological applications.</p>

Course Outcome	Students will be prepared to apply thermodynamics, kinetics, and electrochemistry principles to analyze molecular behavior, reaction mechanisms, energy conversion, and real-world chemical systems.
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Learning Resources	<ol style="list-style-type: none"> 1. Physical Chemistry by G. W. Castellan 2. Atkins' Physical Chemistry by P. Atkins and J. de Paula 3. Heat and Thermodynamics by M. W. Zemansky and R. H. Dittman 4. Basic Chemical Thermodynamics by E. B. Smith 5. The Principles of Chemical Equilibrium by K.G. Denbigh 6. Molecular Thermodynamics by D. A. McQuarrie and J. D. Simon 7. Thermodynamics for Chemists by S. Glasstone 8. Chemical Thermodynamics by I. M. Klotz and R. M. Rosenberg
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Course Code	CH3272N	Course Name	Chemistry Laboratory-II	Course Category	PM	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	
Course Offering Department	Chemistry			Data Book / Codes/Standards	None

Course Objectives	<ol style="list-style-type: none"> 1. "Preparation of organic Compounds" includes the specific organic synthesis to provide students with a practical understanding of key organic reaction mechanisms, isolation processes and modern analytical techniques. 2. Estimation analysis renders students to understand the measurement of the precise amount or percentage composition of specific elements, functional groups, or compounds within a given organic sample.
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Module	Syllabus	Duration (class-hour)	Module Outcome
I	Preparation of important organic compounds: Bromination of aniline or anilides, Nitration of aromatic compounds, Coumarin, Aldol condensation using either a conventional or a green method.	15	1. Students gain practical exposure to the preparation of organic compounds, their identification, and optimized their yields.
II	Determine the amount of aromatic amine (aniline)/ phenol by bromination (bromate-bromide) method. Determine the amount of acetic acid in commercial vinegar	12	2. Students understand the measurement of the precise amount or percentage composition of specific elements, functional groups, or compounds
III	Determination of the isoelectric pH of gelatin	3	

IV	Conductometric titration of an acid (strong/weak, dibasic) against strong base	3	within a given organic sample.
V	Study of kinetics of acid-catalyzed hydrolysis of methyl acetate	3	3. Student will learn basics of redox titration
VI	Estimation of Fe(III) and Mn(II) in a mixture using standardized KMnO_4 solution	3	
VII	Estimation of Fe(III) and Cr(III) in a mixture using $\text{K}_2\text{Cr}_2\text{O}_7$	3	

Course Outcome	Students gain knowledge through the practical course to develop the Analytical Skill, Quality Control, Forensics and Environmental Analysis to estimate the organic compounds, organic substances, organic pollutants etc.
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Learning Resources	<ol style="list-style-type: none"> 1. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, "Vogel's Text Book of Quantitative Chemical Analysis" 2. O.P. Vermani & Narula, "Theory and Practice in Applied Chemistry", New Age International Publishers. 3. Gary D. Christian, "Analytical chemistry", 6th Edition, Wiley India.
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