DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2020
w.e.f. July, 2025-26
B.Sc. Honours in Chemistry (<75% Marks)
4th Year / 7th Semester

S. No.	Course Code	Course Title	(T)Theory (P) Practical	Course Type	Periods per Week			Evaluation Scheme			End Semester	Subject Total	Total Credit	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture	Tutorial	Practical	Class Test	Teacher Assessment	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Values	Professional Ethics	
THEORIES																					
1.	B020701T/CH431	Inorganic Chemistry-I	T	Core Major	05	01	00	15	10	25	75	100	04	√		√					
2.	B020702T/CH432	Organic Chemistry-I	T		05	01	00	15	10	25	75	100	04	√		√		√			
3.	B020703T/CH433	Physical Chemistry-I	T		05	01	00	15	10	25	75	100	04	√	√	√		√	√	√	
4.	B190701T/CH434	Concepts and Applications of Environmental Chemistry	T		05	01	00	15	10	25	75	100	04	√	√	√		√			
PRACTICALS																					
5.	B020704P/CH435	Chemistry Laboratory-I	P	Core Major	00	00	04	15	10	25	75	100	04	√		√					
				TOTAL	**20**	**04**	**04**	**75**	**50**	**125**	**375**	**500**	**20**								

DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2020
w.e.f. July, 2025-26
B.Sc. Honours Chemistry with Research (≥75% Marks)
4th Year / 7th Semester

S. No.	Course Code	Course Title	(T)Theory (P) Practical	Course Type	Periods per Week			Evaluation Scheme			End Semester	Subject Total	Total Credit	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture	Tutorial	Practical	Class Test	Teacher Assessment	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Values	Professional Ethics	
THEORIES																					
1.	B020701T/CH431	Inorganic Chemistry-I	T	Core Major	05	01	00	15	10	25	75	100	04	√		√					
2.	B020702T/CH432	Organic Chemistry-I	T		05	01	00	15	10	25	75	100	04	√		√		√			
3.	B020703T/CH433 or B190701T/CH434	Physical Chemistry-I or Concepts and Applications of Environmental Chemistry	T	Elective	05	01	00	15	10	25	75	100	04	√	√	√		√	√	√	
PRACTICALS																					
4.	B020704P/CH435	Chemistry Laboratory-I	P	Core Major	00	00	04	15	10	25	75	100	04	√		√					
5.	B020705R/CH438	Chemistry Research Project-3	P	Research Project	00	00	08	00	00	00	100	100	04	√	√	√		√	√	√	
				TOTAL	**15**	**03**	**12**	**60**	**40**	**100**	**400**	**500**	**20**								

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020701T/CH431	**Title of the Course**	Inorganic Chemistry-I	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	To develop a comprehensive understanding of metal-ligand bonding models and to enable students to interpret electronic spectra of transition metal complexes, and to equip learners with the knowledge of magnetic behaviour in transition metal compounds, and a hands-on and theoretical exposure to spectroscopic characterization techniques.						

Course Outcomes	
CO1	Analysis of the metal-ligand bonding using Crystal Field Theory and Molecular Orbital Theory would enable students to evaluate splitting patterns in metal complexes, and their geometries including Jahn-Teller effects.
CO2	Explanation of the spectral properties would make students interpret electronic configurations of transition metal ions using term symbols, microstates, and selection rules, and evaluation of transitions by applying Orgel and Tanabe-Sugano diagrams.
CO3	An understanding of the magnetic properties would enable the students to evaluate the magnetic behaviour of transition metal complexes and explain their magnetic properties and predict anomalous behaviour.
CO4	Elaborate comprehension of some important inorganic phenomena would lead the students to apply advanced bonding theories (Walsh diagrams, Bent's rule, dπ–pπ bonding) and analyze the structures of isopoly and heteropoly acids and salts.
CO5	Discussion on the spectroscopic techniques would enable the students to characterize and evaluate inorganic and cluster compounds and explain bonding in cluster compounds.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Theories of Metal-Ligand bonding in complexes	Crystal field theory (CFT) and splitting in octahedral, tetrahedral and square planar complexes, limitations of Crystal field theory, Jahn-Teller effect and Molecular orbital theory.	8	1
2	Colour and electronic spectra	Orbital Angular momentum and Electron Spin Angular momentum, Spin-Orbital Coupling, Russell-Saunders Coupling, Microstates, Energy terms, ground state energy terms, term symbols, ground state term symbol determination of d^1-d^{10} configurations.	8	2
3	Interpretation of Electronic Spectra	Electronic transitions, selection rules, relaxation of selection rules, Orgel, and Tanabe Sugano Diagrams for transition metal complexes with d^1-d^9 configurations. Racah parameters and Nephelauxetic effect. Significance of Dq and β parameters, charge transfer spectra.	8	2
4	Magnetism	Origin of magnetic moment, variation of magnetic susceptibility with temperature, paramagnetism, ferromagnetism, antiferromagnetism and ferrimagnetism, anomalous magnetic behaviour.	7	3
5	Bonding in the main group elements	Walsh diagrams for tri and penta-atomic molecules, Bent rule, dπ-pπ bond	7	4
6	Isopoly and heteropoly acids and salts	Isopoly and heteropoly acids of V, Mo and W, Structures of isopoly and heteropoly anions	7	5
7	Characterization of Inorganic Compounds	Characterization of inorganic compounds by IR, NMR, ESR (Drago's rule, Kramer's Degeneracy), Mossbauer and microscopic techniques.	8	5
8	Cluster compounds	Higher boranes, carboranes, metalloboranes and metallocarboranes and Borazine	7	5

Reference Books:

1. Inorganic Chemistry: Principles of Structure and Reactivity by James E. Huheey, Ellen A. Keiter, and Richard L. Keiter (Pearson Education)
2. Advanced Inorganic Chemistry by F. Albert Cotton, Geoffrey Wilkinson, and Paul L. Gaus (Wiley)
3. Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr (Pearson)
4. Inorganic Chemistry: Principles and Applications by J. Derek Woollins and R. G. Wilkins (Oxford University Press)
5. Concise Inorganic Chemistry by J.D. Lee (Wiley India)

e-Learning Source:

1. https://nptel.ac.in/courses/104106120
2. https://nptel.ac.in/courses/104105034
3. https://www.youtube.com/watch?v=Xs2DDp70rT8
4. https://nptel.ac.in/courses/104105034/modules
5. https://nptel.ac.in/courses/103108100

PO-PSO / CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													SDGs Mapping
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	-	1	3	1	2	3	2	3	1	1	4 (Quality education)
CO2	3	-	1	-	1	3	1	2	3	2	3	2	1	
CO3	3	1	1	-	-	3	1	2	3	2	3	1	1	
CO4	3	1	1	-	-	3	1	3	3	3	3	2	1	
CO5	3	1	1	-	1	3	1	3	3	1	3	1	1	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020702T/CH432	**Title of the Course**	Organic Chemistry-I	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	This course deepens understanding of organic chemistry through advanced bonding concepts, reaction mechanisms, and named transformations. It integrates stereochemical principles to enhance analytical and synthetic skills.						

Course Outcomes	
CO1	Explain bonding characteristics in aromatic, non-aromatic, and antiaromatic systems, including fullerenes, annulenes, and concepts of aromaticity and homoaromaticity.
CO2	Analyze the stability and reactivity of organic reactive intermediates such as carbocations, carbanions, free radicals, carbenes, nitrenes, and benzynes.
CO3	Interpret mechanisms of organic reactions involving addition, elimination, and substitution processes.
CO4	Recognize key named reactions, elucidate their mechanisms, and apply them to synthetic organic transformations.
CO5	Apply stereochemical principles to understand configurational and conformational isomerism.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Nature of bonding in organic molecules	Bonding in fullerenes, Aromaticity in benzenoid and non-benzenoid compound, alternate and nonalternate hydrocarbons, energy of p-molecular orbitals, annulenes, antiaromaticity, Ψ–aromaticity homoaromaticity.	6	1
2	Reactive intermediates	Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes.	6	2
3	Reaction mechanisms	Organic reaction mechanisms involving addition reactions with electrophilic, nucleophilic or radical species. Elimination and substitution reactions with electrophilic, nucleophilic or radical species. Neighbouring group participation, elimination: E2 vs E1, elimination vs substitution.	8	3
4	Name reactions-I	Aldol condensation, Cannizzaro reaction, Reimer-Tiemann reaction. Reformatsky and Grignard reactions, Michael addition, Friedel-Crafts reaction, Witting reaction, Oppenaur-oxidation, Clemmensen reduction.	8	4
5	Name reactions-II	Wolff-Kishner reduction, Meerwein-Ponndorf Verley reduction and birch reduction Mannich reaction, Stobbe condensation, Stork Enamine reaction, Shapiro reaction, Perkin reaction.	8	4
6	Name reactions-III	Woodward hydroxylation, Prevost hydroxylation, Robinson annulations, Sharpless Asymmetric Epoxidation, Ullmann reaction, Benzoin condensation, Dieckmann condensation and Knoevenagel condensation.	8	4
7	Configurational Isomerism	Optical activity and chirality, molecules with one, two or more chiral centres; Fischer's projection formula, relative and absolute configurations, D L, R S, and E Z system of nomenclature. optical activity in absence of chiral carbon (allenes, spiranes, Hemispiranes and biphenyls), chirality due to helical shape.	8	5
8	Conformational Isomerism	Conformation in open chain systems, conformational analysis of cyclopentane, cyclohexane, decalins, Baeyer's strain theory of cyclic compounds and effect of conformation on reactivity. Enantiotopic and diastereotopic atoms, group of faces, stereospecific and stereoselective synthesis, asymmetric synthesis.	8	5

Reference Books:

1. Advanced Organic Chemistry (Reactions, Mechanisms and Structure): Michel B. Smith and Jerry March, 4th Edition, Wiley Inter Science Publication.
2. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Six edition, Pearson publication.
3. Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition, Pearson publication.
4. Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, Second edition, Oxford Publication.
5. Strategic Applications of Named Reactions in Organic Synthesis by Kürti & Czakó

e-Learning Source:

1. https://nptel.ac.in/courses/104105104/
2. https://nptel.ac.in/courses/104101005/
3. https://nptel.ac.in/courses/104103023/
4. https://nptel.ac.in/courses/104106077/
5. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod8.pdf

PO-PSO / CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													SDGs Mapping
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	-	-	2	2	2	3	3	2	3	2	4 (Quality Education) & 9 (Industry, Innovation, and Infrastructure)
CO2	3	2	2	-	2	3	2	2	3	3	3	3	3	
CO3	3	3	2	2	2	3	2	2	3	3	3	3	3	
CO4	3	3	2	2	2	3	2	2	3	3	3	3	3	
CO5	3	3	2	2	2	3	2	2	3	3	3	3	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B190701T/CH433	**Title of the Course**	Physical Chemistry-I	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	5	1	0	4
Pre-Requisite	B. Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	The objective of this course is to describe how gases behave under different conditions. Students will get to study the principles of thermodynamics, understanding energy, heat, work, and entropy and how they relate to spontaneity and equilibrium in chemical systems. Students will also study how and why chemical reactions happen at certain rates, and how temperature and other factors influence these rates. Finally, students will explore photochemistry and radioactive decay. Throughout, the course blends theory with real-world applications to help students grasp the fundamental concepts that govern physical chemistry.						

Course Outcomes	
CO1	Analysis of gas behavior using ideal and real gas laws, interpretation of deviations through critical phenomena and Van der Waals relationships, would enable students to evaluate the significance of critical constants and reduced equations in understanding real gas behavior
CO2	Design and application of thermodynamic models using the laws of thermodynamics, entropy, and energy functions like Gibbs and Helmholtz, would enable students to predict energy changes, spontaneity, and equilibrium in physical and chemical systems.
CO3	Evaluation of the rate and mechanism of chemical reactions through integrated and differential methods would enable students to determine reaction order and assess activation energy using the Arrhenius equation and collision or transition state theories.
CO4	Analysis of radioactive decay as a first-order kinetic process, including natural and induced radioactivity, decay modes, half-life, and units of radioactivity, would enable students to interpret nuclear stability and radioactive transformation mechanisms.
CO5	Application of photochemical laws and interpretation of excited-state processes using Jablonski diagram would enable students to analyze photochemical reaction kinetics and evaluate energy transfer mechanisms in photosensitized reactions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Properties of Gases	The states of gases, gases laws and deviation from ideal behavior, Vander Waals equation of state; Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.	7	1
2	Thermodynamics - 1	System & surroundings, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work. First Law of Thermodynamics; Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure, Joule's law – Joule Thomson coefficient and inversion temperature.	8	2
3	Thermodynamics - 1I	Second Law of Thermodynamics: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and equilibrium, Equilibrium change in ideal gases and mixing of gases, Maxwell's relations.	7	2
4	Entropy and Free energy	Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. Nernst heat theorem, statement and concept of residual entropy.	7	2
5	Chemical Kinetics	Rate of a reaction, factors influencing the rate of a reaction; mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo-order, half-life and mean life, Determination of the order of reaction-differential method, method of integration, method of half-life period and isolation method. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.	8	3
6	Radio-kinetics	Radioactive decay as a first order phenomenon, Natural and induced radioactivity; radioactive decay-a-decay, b-decay, g-decay; neutron emission, positron emission, electron capture; unit of radioactivity (Curie); half life period.	7	4
7	Photochemistry	Interaction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law Jablonski diagram depicting various processes occurring in the excited state, Lambert- Beer Law: quantum Efficiency and its determination, Qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing)	8	5
8	Application of	Photosensitized reactions – energy transfer processes (simple examples), Kinetics	8	5

	Photochemistry	of Photo-chemical reaction; Hydrogen-Bromine, Hydrogen-Chlorine, Decomposition of Hydrogen Iodide and kinetics of dimerization of Anthracene.		

Reference Books:

1. Physical Chemistry, by Peter Atkins & Julio de Paula
2. An Introduction to Chemical Thermodynamics, by R P Rastogi & R R Mishra
3. Physical Chemistry, Puri, Sharma & Pathania
4. Nuclear and Radiochemistry by Gerhart Friedlander, Joseph W. Kennedy, and Julian M. Miller
5. Fundamentals of Photochemistry by K.K. Rohatgi-Mukherjee

e-Learning Source:

1. https://youtu.be/o9ueYSKj9og?si=E-2PpMtO6S1YpWKT
2. https://youtu.be/S73srEM_4QA?si=2Lzpq1dkYNb1bojT
3. https://youtu.be/umV67dqWVKw?si=4FF0gqiBhxAe2lY4
4. https://youtu.be/zVEKh_mCGqw?si=icpxXtZO07hOTc9T
5. https://www.youtube.com/watch?v=SgTuWj9Tj80

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													SDGs Mapping
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	1	1	2	2	2	2	1	2	1	1	4 (Quality Education) & 9 (Industry, Innovation, and Infrastructure)
CO2	3	1	1	1	1	3	3	3	3	2	3	3	1	
CO3	3	2	1	1	1	3	2	2	3	2	3	2	1	
CO4	3	1	1	1	2	3	3	2	2	2	2	2	1	
CO5	3	2	1	1	2	3	3	3	3	2	3	3	1	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B190702T/CH434	**Title of the Course**	Concepts and Applications of Environmental Chemistry	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	5	1	0	4
Pre-Requisite	B. Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	This course provides students with essential knowledge of environmental chemistry principles, including chemical equilibria, atmospheric and water chemistry, soil composition, and pollutant behavior. It covers analytical methods for environmental assessment and emphasizes quality standards, quality assurance, and control in air, water, and soil monitoring within the Indian regulatory context.						

Course Outcomes	
CO1	Given key chemical principles, students will be able to formulate and apply strategies for evaluating environmental processes and managing pollutants and radiochemical substances.
CO2	For various atmospheric systems, students will integrate and apply chemical principles to interpret the formation, transformation, and environmental impact of air pollutants, reactive radicals, and photochemical reactions.
CO3	Given physicochemical data, students will differentiate and examine the chemical parameters affecting water and soil quality, including redox reactions and nutrient cycles essential for environmental assessment.
CO4	For diverse environmental samples, students will evaluate and select appropriate analytical techniques such as titrimetry, chromatography, spectrophotometry, and atomic absorption for accurate quality assessment.
CO5	Given national environmental quality standards, students will apply QA/QC procedures to monitor and assess the quality of drinking water, air, and soil effectively.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamental of environmental chemistry	Mole Concept, Solution chemistry, solubility product, Solubility of gases, Phase change, chemical kinetics and chemical equilibrium. Sources of natural and artificial radiation, Applications and handling of isotopes and other radionuclides in environment.	8	1
2	Chemistry for Environment	Concept of environmental chemistry; Chemical equilibrium, Conductance; Oxidation and reduction; Acid, bases and salts; Chemistry of various organic and inorganic compounds; Surfactants and pollution caused by surfactants.	7	1
3	Atmospheric Chemistry	Chemical composition of air, Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo-chemical and photochemical reactions in the atmosphere. CFC's and Ozone chemistry, chemistry of air pollutants, photochemical smog.	8	2
4	Environmental aspects of water chemistry	Structure and properties of water, Water quality parameters, Physicochemical concepts of color, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, carbonate system in water, total hardness, redox reactions and disinfection methods.	7	3
5	Environmental aspects of soil chemistry	Soil formation, composition and classification; Soil profile; Soil erosion; Inorganic and Organic components of soil -Nitrogen pathways in soil; NPK in soils.	7	3
6	Principles of commonly used analytical methods in environmental quality assessment-A	Titrimetry; Gravimetry; Colorimetry; Flame photometry; Basic Chromatography; GC; GLC, HPLC.	7	4
7	Principles of commonly used analytical methods in environmental quality assessment-B	Spectrophotometry; Atomic absorption spectrophotometry; Electrophoresis; X-Ray fluorescence, X-Ray diffraction; Inductive coupled plasma spectroscopy.	8	4
8	Quality Standards	Introduction to Environmental Quality Standards, Basic Concepts in Quality Assessment: Introduction to quality assurance and quality control (QA/QC) in environmental monitoring. Drinking Water Quality Standards (with emphasis on BIS IS:10500:2012), National Ambient Air Quality Standards (NAAQS) (as per CPCB notification) and Soil Quality Guidelines/Standards (Indian context).	8	5

Reference Books:

1. Environmental Chemistry Manahan, Stanley E, 2004, Taylor & Francis Ltd.
2. Basic Concepts of Environmental Chemistry, Desley W. Connell, 1 edition, CRC-Press
3. Environmental Chemistry: A Global Perspective, Gary W. Vanloon Stephen J. Duffy, Oxford Univ Pr (Sd).
4. Introduction to Environmental Chemistry, Reid, Brian J. Blackwell ScienceLtd.

5. Chemistry of the Environment, Thomas G. Spiro, William M. Stigliani, 2nd Edition, Prentice Hall publication
e-Learning Source:
1 https://archive.nptel.ac.in/courses/104/103/104103020
2. https://archive.nptel.ac.in/courses/104/103/104103112
3. https://archive.nptel.ac.in/courses/103/106/103106118
4. https://archive.nptel.ac.in/courses/126/105/126105017
5. https://archive.nptel.ac.in/courses/115/106/115106117

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	-	3	3	2	3	3	3	3	3	3	2	3	6 (Clean Water and Sanitation) & 11 (Sustainable Cities and Communities)
CO2	3	-	3	3	2	3	3	3	2	1	2	-	3	
CO3	3	-	3	3	2	3	3	3	2	1	2	-	3	
CO4	3	-	-	-	3	3	-	2	3	3	3	3	3	
CO5	3	-	2	3	3	3	2	2	3	3	3	2	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B20703P/CH435	**Title of the Course**	Chemistry Laboratory-I	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	0	0	4	2
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	To impart essential practical knowledge in chemistry and develop practical/technical skills pertinent to qualitative analysis of inorganic and organic mixtures and determination of molecular weight, rate constant, etc., along with a hands-on exposure to the separation and analysis of unknown chemical moieties through chromatographic techniques. The course also aims to promote transferable skills (teamwork, time management).						

Course Outcomes	
CO1	Understanding the essentials of qualitative analysis would enable students to identify unknown inorganic and organic mixtures
CO2	The ability to analyze the purity of a substance and the basics of synthesis would help students develop an aptitude towards research.
CO3	An understanding of the determination of molecular weight and surface tension would enable the students to assess important physical characteristics of a given sample.
CO4	Assessment of rate constant, order of reaction, conductance, etc., would help students understand and apply physical chemistry concepts.
CO5	A practical implementation of different chromatographic techniques would enable students to identify unknown components in an unknown mixture.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Inorganic Chemistry	• To qualitatively analyze the given mixture for not more than 8 radicals • To prepare $Na[Fe(EDTA)]\cdot 3H_2O$	15	1,2
2	Organic Chemistry	• To separate, purify, and identify the given organic mixture by making suitable derivatives of the three-component Organic mixture (three solids or two solids and one liquid or two liquids and one solid) involving all the functional groups. • Use TLC for checking the purity of the separated compounds and their derivatives and report their Rf values.	15	1,2
3	Physical Chemistry	• To determine the relative surface tension, parachor and molecular surface energy of a liquid by Stalagnometer. • To determine the molecular weight of non-volatile solute by using the Rast camphor method. • To determine the rate constant and order of reaction for the hydrolysis of an ester by NaOH(saponification). • To find out the equivalent conductance of a strong electrolyte at different concentrations at room temperature and test the validity of the Onsager equation. • To determine the basicity of a given salt by the conductance method.	15	3,4
4	Analytical/General Chemistry	• To separate metal ions by paper chromatography • To separate amino acids by thin-layer chromatography • To separate a mixture of carbohydrates by thin-layer chromatography. • To separate plant pigments from green leaves by column chromatography. • To determine Total Dissolved Solids (TDS) /Chemical Oxygen Demand (COD) in the given water sample.	15	5

Reference Books:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati publication.
2. Practical Organic Chemistry, A.I.Vogel.
3. Experimental Inorganic Chemistry –W.G.Palmer.
4. Advanced physical practical chemistry by J B Yadav Goel publication
5. University practical Chemistry; P C Kamboj by Vishal Publication

e-Learning Source:

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
3. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

PO-PSO / CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													SDGs Mapping
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	-	-	-	2	-	3	3	1	1	1	2	SDG-4 (Quality Education)
CO2	3	2	-	-	-	2	-	3	3	1	2	2	3	
CO3	3	2	-	-	-	2	-	3	3	1	3	3	2	
CO4	3	2	-	-	-	2	-	3	3	1	2	2	2	
CO5	3	2	-	-	-	2	2	3	3	1	2	2	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020705R/CH438	**Title of the Course**	Chemistry Research Project-3	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	0	0	8	4
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	To develop students' ability to conduct independent investigations, interpret data using appropriate analytical techniques, and compile their findings into a comprehensive project dissertation aligned with academic and industrial standards.						

Course Outcomes	
CO1	Demonstrate the ability to conduct independent literature reviews to identify relevant research gaps and design appropriate experimental approaches in industrial chemistry.
CO2	Carry out experimental procedures for the synthesis or analysis of chemical compounds using standard laboratory practices and safety protocols.
CO3	Apply appropriate analytical and characterization techniques (such as FTIR, UV-Vis, GC, or XRD) to evaluate the physicochemical properties of synthesized compounds.
CO4	Analyze and interpret experimental data effectively to draw valid conclusions that support the research objectives.
CO5	Prepare and present a well-structured research dissertation that clearly communicates the methodology, results, discussion, and implications of the research in a professional format.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	-	-	2	1	2	2	3	1	3	2	2	4 (Quality Education), 9 (Industry, Innovation, and Infrastructure), & 12 (Responsible Consumption and Production)
CO2	1	3	-	2	2	1	2	2	2	2	1	1	1	
CO3	2	3	1	2	1	1	2	2	2	1	1	1	3	
CO4	1	3	2	2	1	-	-	2	1	2	2	2	1	
CO5	1	2	1	-	1	2	2	2	-	2	1	-	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2020
w.e.f. July, 2025-26
B.Sc. Honours in Chemistry (<75% Marks)
4th Year / 8th Semester

S. No.	Course Code	Course Title	(T)Theory (P) Practical	Course Type	Periods per Week			Evaluation Scheme			End Semester	Subject Total	Total Credit	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture	Tutorial	Practical	Class Test	Teacher Assessment	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Values	Professional Ethics	
THEORIES																					
1.	B020801T/CH445	Inorganic Chemistry-II	T	Core Major	05	01	00	15	10	25	75	100	04	√		√					
2.	B020802T/CH446	Organic Chemistry-II	T		05	01	00	15	10	25	75	100	04	√		√		√			
3.	B020803T/CH447	Physical Chemistry-II	T		05	01	00	15	10	25	75	100	04	√	√	√		√	√	√	
4.	B190804T/CH442	Advanced Analytical Techniques	T		05	01	00	15	10	25	75	100	04	√	√	√		√			
PRACTICALS																					
5.	B020805P/CH448	Chemistry Laboratory-II	P	Core Major	00	00	04	15	10	25	75	100	04	√		√					
				TOTAL	**20**	**04**	**04**	**75**	**50**	**125**	**375**	**500**	**20**								

DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2020
w.e.f. July, 2025-26
B.Sc. Honours Chemistry with Research (≥75% Marks)
4th Year / 8th Semester

S. No.	Course Code	Course Title	(T)Theory (P) Practical	Course Type	Periods per Week			Evaluation Scheme			End Semester	Subject Total	Total Credit	Attributes							United Nations Sustainable Development Goals (SDGs)
					Lecture	Tutorial	Practical	Class Test	Teacher Assessment	Total				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Values	Professional Ethics	
THEORIES																					
1.	B020801T/CH445	Inorganic Chemistry-II	T	Core Major	05	01	00	15	10	25	75	100	04	√		√					
2.	B020802T/CH446	Organic Chemistry-II	T		05	01	00	15	10	25	75	100	04	√		√		√			
3.	B020803T/CH447 Or B190804T/CH442	Physical Chemistry-II Or Advanced Analytical Techniques	T	Elective	05	01	00	15	10	25	75	100	04	√	√	√		√	√	√	
PRACTICALS																					
4.	B020805P/CH448	Chemistry Laboratory-II	P	Core Major	00	00	04	15	10	25	75	100	04	√		√					
5.	B020806R/CH449	Chemistry Research Project-4	P	Research Project	00	00	08	00	00	00	100	100	04	√	√	√		√	√	√	
				TOTAL	**15**	**03**	**12**	**30**	**40**	**100**	**400**	**500**	**20**								

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020701T/CH445	**Title of the Course**	Inorganic Chemistry-II	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**					
Course Objectives	To develop a foundational and advanced understanding of metal-ligand complex stability, and to introduce the principles and mechanisms of substitution reactions in complexes, along with a comprehensive understanding of organometallic chemistry, interpretation of structures, bonding, and reactivity of metal carbonyls and their clusters.						

Course Outcomes	
CO1	Analysis of the thermodynamic and kinetic stability of metal-ligand complexes using valence bond theory and crystal field theory, and explanation of the factors affecting complex stability, would provide insight into the dynamics of coordination complexes
CO2	Explanation and comprehension of the mechanisms of substitution reactions in complexes would enable students to predict the reaction feasibility and application in the design of new complexes.
CO3	A detailed evaluation of the outer-sphere and inner-sphere mechanisms of transition metal complexes would make students analyze and predict the formation of complexes
CO4	Discussion on organometallic chemistry and its applications in catalysis would enable students to predict and analyze their reactivity in key transformations such as oxidative addition and migratory insertion etc.
CO5	An elaborate discussion on cluster compounds would enable the students to interpret the structure and bonding in metal carbonyls and carbonyl clusters by applying IR spectroscopy, Wade–Mingos rules, and isolobal analogy, and assess their reactions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Metal-ligand equilibria and concerning factors	Kinetic and thermodynamic stability and lability, stability constants. Interpretation of lability and inertness of transition metal complexes on the basis of Valence Bond and Crystal Field theories. Trends in stepwise constant. Factors affecting the stability of metal complex with reference to the nature of metal ion and ligand.	8	1
2	Substitution reactions in Inorganic Complexes	Substitution reactions in octahedral and square planar complexes, Trans effect, theories of trans-effect-Grinberg's electrostatic polarization theory, application of trans-effect to synthesis of complexes.SN^1, SN^2, SN^1CB mechanisms, and factors affecting substitution reactions in inorganic complexes.	8	2
3	Reaction mechanisms of transition metal complexes	Electron transfer reactions, mechanism of one-electron transfer reactions-outer sphere and inner sphere mechanisms, two-electron transfer reactions-complimentary and non-complimentary reactions, mechanism of two-electron transfer reactions.	8	3
4	Introduction to organometallic chemistry	Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, nomenclature of organometallic compounds, Reactions in organometallic chemistry (oxidative addition, reductive elimination, migratory insertion, beta hydride elimination)	8	4
5	Chemistry of metal carbonyls	Structure, π-bonding and IR spectroscopy, bonding modes of CO, synergistic effect, factors affecting the magnitude of stretching frequency, reactions of metal carbonyls including activation, disproportionation, electrophilic addition and nucleophile addition etc.	8	5
6	Metal carbonyl clustres	Synthesis and Reactions of metal carbonyl clusters, Dinuclear cluster, Low nuclearity carbonyl cluster (LNCC) and High nuclearity carbonyl cluster (HNCC), Capping rules, Polyhedral skeletal electron pair approach (Wade and Mingo's rule), isolabal analogy	8	5
7	Applications of Organometallic Chemistry	Catalytic cycles of Wacker process, Wilkinson's catalyst in hydrogenation of alkenes, Monsanto's process, hydroformylation of alkenes (Oxo process).	6	4
8	Ferrocene: structure, Bonding and reactions	Structure and bonding of ferrocene, Reactions of ferrocene and its derivatives, Ferrocene derivatives in asymmetric catalysis	6	5

Reference Books:

1. Inorganic Chemistry, by J.D. Lee
2. Inorganic Chemistry: Principles of Structure and Reactivity, by James E. Huheey, Ellen A. Keiter, Richard L. Keiter
3. Advanced Inorganic Chemistry, by F.A. Cotton and G. Wilkinson
4. Organometallic Chemistry, by R.C. Mehrotra and A. Singh
5. Concise Coordination Chemistry, by R.Gopalan and V. Ramalingam

e-Learning Source:

1. https://nptel.ac.in/courses/104105033

2.	https://www.youtube.com/watch?v=n4cIKKI3_eU
3.	https://nptel.ac.in/courses/104101136
4.	https://nptel.ac.in/courses/104101091
5.	https://nptel.ac.in/courses/104101091

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													SDGs Mapping
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	-	1	3	3	1	3	2	3	1	1	SDG-4 (Quality Education) SDG-9 (Industry, Innovation and Infrastructure)
CO2	3	-	1	-	1	2	2	1	3	2	3	1	1	
CO3	3	-	1	-	1	2	2	1	3	2	3	1	1	
CO4	3	-	1	-	1	2	1	2	3	2	3	1	2	
CO5	3	1	1	1	1	2	2	2	3	2	3	1	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020802T/CH446	**Title of the Course**	Organic Chemistry-II	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	This course aims to equip learners with a comprehensive understanding of advanced reaction processes in organic chemistry. It focuses on the mechanisms and synthetic significance of key molecular rearrangements, the strategic use of classical and contemporary reagents, and the stereochemical insights governing pericyclic reactions. Students will also explore the principles of photochemistry and excited-state dynamics, culminating in the evaluation of photochemical transformations involving alkenes and carbonyl compounds to support innovative synthetic design.						

Course Outcomes	
CO1	Explain and compare the mechanisms and synthetic relevance of key molecular rearrangements, including Pinacol, Beckmann, and Curtius reactions.
CO2	Identify and apply classical and modern reagents (e.g., $LiAlH_4$, LDA, PCC) in diverse organic transformations.
CO3	Analyze pericyclic reactions electrocyclic, cycloaddition, and sigmatropic using orbital symmetry and stereoelectronic principles.
CO4	Interpret photochemical behavior of aromatic systems via Jablonski diagrams and relate it to reaction pathways.
CO5	Evaluate the synthetic utility and mechanisms of photochemical processes involving alkenes and carbonyl compounds.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Molecular Rearrangements-I	Pinacol-pinacolone rearrangements, Wagner-Meerwein rearrangements, Benzil-Benzilic acid rearrangements, Wolf rearrangements, Sommelet Hauser rearrangements Baeyer Villiger rearrangements, Dakin rearrangements.	6	1
2	Molecular Rearrangements-II	Hofmann rearrangements, Curtius rearrangements, Schmidt rearrangements, Lossen rearrangements, Beckmann rearrangements, Neber rearrangements, Favorskii rearrangements and Fries rearrangements	6	1
3	Reagents in Organic Synthesis-I	Aluminium Isopropoxide, Aluminium tertiary butoxide, Anhydrous $AlCl_3$, N-Bromosuccinamide (NBS), Dicyclohexylcarbodiimide (DCC), Lithium aluminium hydride (LiAlH4), Sodium borohydride (NaBH4).	8	2
4	Reagents in Organic Synthesis-I	Gilman's reagent (lithium dimethyl cuprate), Lithium diisopropylamide (LDA), trimethylsilyl iodide, Wilkinson's catalyst, Pyridinium Chlorochromate (PCC), Perbenzoic acid	8	2
5	Pericyclic reactions; Electrocyclic Reactions	General pericyclic selection rules and their applications, Frontier molecular, π molecular orbital of ethylene, 1,3-butadiene, 1,3,5-herxatriene. Electrocyclic reactions: Introduction, conrotatory and disrotatory motions of 4nπ and [4n+2]π systems. Stereochemistry for the ring opening and ring closing electrocyclic reactions, thermal and photochemical cyclisation of (4n) and (4n+2) system.	8	3
6	Cycloaddition and Sigmatropic Reactions	Thermal and photochemical induced (2+2) and (4+2) cycloaddition reactions. General orbital symmetry rules: [2+2] cycloaddition reactions, [4+2] cycloaddition reactions, cheletropic cycloaddition, 1,3-dipolar cycloadditions including click chemistry; Sigmatropic reactions: (1,3), (1,5), (1,7), (2,3), (3,3), Cope and Claisen rearrangement.	8	3
7	Basics and Photochemistry of Aromatic Compounds	Excited states and ground state, singlet and triplet states. forbidden transitions, fate of the excited molecules: Jablonski diagram, fluorescence and phosphorescence. Synthetic applications of Barton and Hoffman-Loefller Freytag reactions.	8	4
8	Photochemistry of Alkenes and Carbonyl Compounds	Photochemical additions; reactions of 1,3-, 1,4- and 1,5-dienes: Di-pie-methane rearrangement, Photochemistry of carbonyl compounds: Norrish type I & II reactions (cyclic and acyclic), α,β-unsaturated ketones; cyclohexenones (conjugated), Paterno–Buchi, photooxidation and photoreduction.	8	5

Reference Books:

1. Advanced Organic Chemistry (Reactions, Mechanisms and Structure): Michel B. Smith and Jerry March, 4th Edition, Wiley Inter Science Publication.
2. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Six edition, Pearson publication.
3. Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition, Pearson publication.
4. Modern Physical Organic Chemistry – Anslyn & Dougherty
5. Organic Reaction Mechanisms – Grossman

e-Learning Source:
6. https://nptel.ac.in/courses/104105104/
7. https://nptel.ac.in/courses/104101005/
8. https://www.organic-chemistry.org/namedreactions/beckmann-rearrangement.shtm
9. https://www.youtube.com/watch?v=F_xKfs4gzLg
10. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod8.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	–	2	3	2	2	3	3	2	3	3	4 (Quality Education) & 9 (Industry, Innovation, and Infrastructure)
CO2	3	2	–	–	2	3	2	2	3	3	3	3	3	
CO3	3	2	–	–	–	3	2	2	3	3	2	3	3	
CO4	3	2	–	–	–	3	2	2	3	3	2	3	3	
CO5	3	2	–	–	–	3	2	2	3	3	2	3	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020803T/CH447	**Title of the Course**	Physical Chemistry-II	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	5	1	0	4
Pre-Requisite	B. Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	The objective of this course is to understand and apply the principles of electrochemistry, including ionic conductance, electrode potentials, electrochemical cells, and activity coefficients, to analyze chemical systems and processes. Students will explore electrode kinetics, corrosion mechanisms, and methods of corrosion prevention through a combination of theoretical and practical approaches.						

Course Outcomes	
CO1	Evaluation of the conductive behavior of electrolytes and metals by applying ionic dissociation and transport theories would enable students to assess conductivity data and determine dissociation constants, solubility products, and ionic properties using classical electrochemical methods.
CO2	Analysis of electrochemical and concentration cell functioning, interpretation of electrode potentials through the Nernst equation, would enable students to evaluate ionic activities, pH, and solubility using potentiometric techniques and electrochemical measurements.
CO3	Analysis of the structure and thermodynamic behavior of electrified interfaces using models like Gouy-Chapman, Stern, and Bockris-Devanathan would enable students to apply the Lippmann equation to interpret surface excess and electro-capillary phenomena.
CO4	Development of kinetic models for electrode reactions using concepts of overpotential, current-potential relationships, and equations such as Tafel and Butler–Volmer would enable students to predict and design electrochemical behavior in practical systems.
CO5	Analysis of the fundamental causes and mechanisms of corrosion would enable students to assess corrosion monitoring and prevention techniques for controlling material degradation in real-world applications.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Electrochemistry-I	Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar, equivalent and specific conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes. Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager equation for strong electrolytes.	8	1
2	Applications of Electrochemistry-I	Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements: Determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt.	7	1
3	Electrochemistry- II	Electrochemical cell (Galvanic Cell), Types of reversible electrodes- Gas-metal ion, metal-ion, metal- insoluble salt-anion and redox electrodes. Electrode reactions, single electrode potential, standard electrode potential. Reference electrode: standard hydrogen electrode and calomel electrode, Nernst equation, derivation of cell E.M.F., electrochemical series and its significance.	8	2
4	Applications of Electrochemistry-II	Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient. Determination of pH using quinhydrone, calomel and glass electrodes by potentiometric method.	7	2
5	Electrochemistry of solution	Activity, activity coefficient, Debye-Huckel limiting law, determination of activity and activity coefficient, ionic strength.	7	2
6	Thermodynamics of electrified interface	Thermodynamics of electrified interface equation, deviation of electro-capillary, Lippmann equation (surface excess), methods of determination, structure of electrified interfaces. Helmoltz-Perrin, Guoy Chapman, and Stern model.	8	3
7	Electro-kinetics	Mechanism of electrode reaction, overpotential current, current potential relation, Tafel equation, over-voltage and decomposition potential, Butler Volmer equation.	8	4
8	Corrosion	Introduction to corrosion, homogenous theory form of corrosion, corrosion monitoring and prevention methods.	7	5
Reference Books:				

1. Physical Chemistry by Puri, Sharma & Pathania
2. Electrochemistry by R. Gopalan, D. Vijayaraghavan & S. Nagarajan
3. Modern Electrochemistry" (Vol I & II) by John O'M. Bockris and Amulya K.N. Reddy
4. Electrochemical Methods: Fundamentals and Applications (2nd ed.) by A.J. Bard & L R Faulkner
5. Electrochemistry and Solutions Volume 3 by K. L. Kapoor's
e-Learning Source:
1. https://youtu.be/rHMZ1Dpk5Fc?si=tDI1GjAlGUMD4Hmv
2. https://youtu.be/zxgJst95eIg?si=f5ts5Awpzk_y7Gg1
3. https://youtu.be/AeoRKZcDs64?si=sH5dwrUnpcRGvrP-
4. https://youtu.be/fZUU42KlwCA?si=eKcJgIZYmKNAwwuC

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	1	1	3	2	3	2	2	3	2	1	4 (Quality Education) & 9 (Industry, Innovation, and Infrastructure)
CO2	3	2	1	1	1	3	2	3	3	2	3	3	1	
CO3	3	1	1	1	1	3	2	2	3	2	3	3	1	
CO4	3	2	1	1	2	3	2	3	3	2	3	3	1	
CO5	3	2	2	2	2	3	3	2	2	2	3	2	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B190804T/CH442	**Title of the Course**	Advanced Analytical Techniques	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	This course introduces key analytical techniques for chemical analysis, covering spectroscopy, chromatography, thermal methods, and mass spectrometry. It also explains X-ray diffraction for structural insights into crystalline materials.						

Course Outcomes	
CO1	Analyze and interpret UV-Vis, IR, NMR, and MS spectra to elucidate and design molecular structures and functional groups.
CO2	Evaluate AAS and ICP-MS data to quantify trace elements and heavy metals through flame and plasma atomization techniques.
CO3	Interpret TGA, DTA, and DSC thermograms to characterize decomposition, phase transitions, and thermal stability of materials.
CO4	Apply advanced chromatographic techniques (UPLC, LC-MS, GC-MS) to resolve and develop methods for complex chemical matrices.
CO5	Utilize Bragg's Law and single-crystal XRD to construct crystal structures and assess lattice parameters of solid-state compounds.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	UV-Visible Spectroscopy	Basic principles, instrumentation, Woodward-Fieser rules, conjugated systems, absorption bands, solvent effects of electronic transitions	6	1
2	Infrared Spectroscopy	Principle of IR spectroscopy- Hooke's law, Vibrational modes, instrumentation, characteristic absorption and fingerprint region, IR frequencies of different functional groups and carbonyl compounds.	8	1
3	NMR Spectroscopy	^{1}H and ^{13}C NMR principle, chemical shift, splitting patterns, Nuclear Over Hauser Effect (NOE), relaxation processes, interpretation of NMR spectra of some organic compounds, coupling constant, 2D NMR	8	1
4	Mass Spectrometry	Single and triple quadrupole mass spectrometer, Ionization methods (EI, CI, FAB), fragmentation patterns, McLafferty rearrangement, Nitrogen rule, metastable and molecular ion peaks	8	1
5	Atomic Absorption Spectrophotometry	Principle, Instrumentation, atomization techniques; Flame ionization, inductively coupled Plasma (ICP), AAS and ICP-MS for heavy metals and trace elements analysis.	8	2
6	Thermal Analytical Techniques	Principles and instrumentation of TGA, DTA, DSC; data interpretation and applications in polymers and materials	8	3
7	Chromatographic Techniques	Principles and Classifications of chromatographic methods. Ultra Performance Liquid Chromatography (UPLC): High pressure and speed for improved resolution. Hyphenated Techniques: LC-MS, GC-MS, LC-NMR–principles and real-world. Derivatization and headspace sampling.	8	4
8	X-Ray Diffractometery	Principle, X-ray diffraction and Bragg's Law, Single crystal X-ray diffraction, instrumentation and applications	6	5

Reference Books:

1. Pavia, D. L., Lampman, G. M., & Kriz, G. S. Introduction to Spectroscopy, Cengage Learning.
2. Skoog, D. A., West, D. M., Holler, F. J. Fundamentals of Analytical Chemistry, Harcourt.
3. Kemp, W. Organic Spectroscopy, Palgrave.
4. Christian, G. D. Analytical Chemistry, Wiley.
5. Banwell, C. N., & McCash, E. M. Fundamentals of Molecular Spectroscopy, McGraw-Hill.

e-Learning Source:

1. https://nptel.ac.in/courses/103108100
2. https://nptel.ac.in/courses/112106227
3 https://youtu.be/CzM-F28a0Uk
4. https://youtu.be/l2ENx_Y0dNU
5. https://youtu.be/PMq02umihQk

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	-	-	3	3	2	2	2	3	2	3	3	4 (Quality Education) & 9 (Industry, Innovation, and
CO2	3	2	-	-	2	2	2	1	1	2	2	2	2	
CO3	3	1	-	-	2	3	3	1	1	3	2	2	2	
CO4	3	2	2	1	2	3	3	1	1	3	2	3	2	

CO5	3	3	1	1	2	3	3	2	2	3	3	3	3	Infrastructure)

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-2026							
Course Code	B020805P/CH448	**Title of the Course**	Chemistry Laboratory-II	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	0	0	4	2
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	To impart practical knowledge on the quantitative aspects of inorganic chemistry and gain a hands-on exposure to inorganic and organic synthesis and determination of important physical properties like dissociation constant, solubility of a sparingly soluble substance, and estimation of calcium and ascorbic acid.						

Course Outcomes	
CO1	Understanding the essentials of quantitative analysis would enable students to separate metal ions and gain insight into inorganic synthesis.
CO2	Practical implementation of organic synthesis would enable the students to help understand the basics of organic reactions and their practical implementation.
CO3	An understanding of the determination of equivalence conductance, solubility product etc. would enable the students to assess important physical phenomena.
CO4	Practical implementation of the concepts of reaction kinetics would help students to determine and assess the important characteristics of a chemical reaction.
CO5	Practical assessment of important compounds like calcium carbonate and ascorbic acid would help students to identify and quantify chemical content in an unknown sample, for quality control.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Inorganic Chemistry	• To quantitatively analyze and separate two metal ions, Cu-Ni, Cu-Zn., Cu-Fe, etc., involving volumetric and gravimetric methods. • To prepare the given inorganic complex compounds and calculate the % yield: $K_3[Fe(C_2O_4)$; Prussian Blue, Turnbull's Blue; $[Ni(DMG)_2]$ $[Cu(NH_3)_4]SO_4.H_2O$	15	1
2	Organic Chemistry	• Two-step synthesis involving: 1. Acetylation 2. Oxidation 3. Grignard reaction 4. Aldol condensation 5. Sandmeyer reaction 6. Acetoacetic ester Condensation 7. Cannizzaro reaction 8. Friedel-Craft reaction 9. Aromatic Electrophilic Substitution	15	2
3	Physical Chemistry	• To determine the equivalent conductance of a weak electrolyte at different concentrations and hence test the validity of Ostwald's dilution Law. • To determine the dissociation constant Ka/Kb of the weak electrolyte. • To determine the solubility of a sparingly soluble substance in water at a given temperature by the conductance method. • To determine the rate constant for the inversion of cane sugar using a polarimeter. • To study the kinetics of decomposition of the complex formed between sodium sulphide and sodium nitroprusside spectrophotometrically, and also find the order and rate constant of the reaction.	15	3,4
4	Analytical/General Chemistry	• To estimate calcium as $CaCO_3$ in chalk • To prepare Paracetamol. • To estimate ascorbic acid in the given fruit juice sample.	15	5

Reference Books:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Publication.
2. Practical Organic Chemistry, A.I.Vogel.
3. Experimental Inorganic Chemistry –W.G.Palmer.
4. Advanced Physical Practical Chemistry by J B Yadav Goel Publication
5. University practical Chemistry; P C Kamboj by Vishal Publication

e-Learning Source:

1. https://www.srcollege.edu.in/temp/lms/Manuals/OrganicChemistry.pdf
2. https://science-blogs.ucoz.com/resources/notes/msc/pract1/Volumetric.pdf
3. https://www.studocu.com/in/document/tezpur-university/chemistry/physical-chemistry-manual/7882747

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													SDGs Mapping
PO-PSO / **CO**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	-	-	1	2	2	3	3	3	3	2	3	SDG-4 (Quality Education)
CO2	3	2	-	-	1	2	2	3	3	3	3	2	3	
CO3	3	2	-	-	1	2	-	3	3	3	3	2	3	
CO4	3	2	-	-	1	2	-	3	3	3	3	2	3	
CO5	3	2	-	-	1	2	2	3	3	3	3	2	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

B.Sc. Honours in Chemistry/
B.Sc. Honours Chemistry with Research

Effective from Session: 2025-26							
Course Code	B020806R/CH449	**Title of the Course**	Chemistry Research Project-4	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	0	0	8	4
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	To develop students' ability to conduct independent investigations, interpret data using appropriate analytical techniques, and compile their findings into a comprehensive project dissertation aligned with academic and industrial standards.						

Course Outcomes	
CO1	Demonstrate the ability to conduct independent literature reviews to identify relevant research gaps and design appropriate experimental approaches in industrial chemistry.
CO2	Carry out experimental procedures for the synthesis or analysis of chemical compounds using standard laboratory practices and safety protocols.
CO3	Apply appropriate analytical and characterization techniques (such as FTIR, UV-Vis, GC, or XRD) to evaluate the physicochemical properties of synthesized compounds.
CO4	Analyze and interpret experimental data effectively to draw valid conclusions that support the research objectives.
CO5	Prepare and present a well-structured research dissertation that clearly communicates the methodology, results, discussion, and implications of the research in a professional format.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	-	-	2	1	2	2	3	1	3	2	2	4 (Quality Education), 9 (Industry, Innovation, and Infrastructure), & 12 (Responsible Consumption and Production)
CO2	1	3	-	2	2	1	2	2	2	2	1	1	1	
CO3	2	3	1	2	1	1	2	2	2	1	1	1	3	
CO4	1	3	2	2	1	-	-	2	1	2	2	2	1	
CO5	1	2	1	-	1	2	2	2	-	2	1	-	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**