DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2020
w.e.f. July, 2025-26
B.Sc. Honours in Industrial 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.	B190702P/CH437	Industrial 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 Industrial 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.	B190702P/CH437	Industrial Chemistry Laboratory-I	P	Core Major	00	00	04	15	10	25	75	100	04	√		√					
5.	B190703R/CH436	Industrial 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 Industrial Chemistry/B.Sc. Honours Industrial 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 behavior in transition metal compounds, and a hands-on and theoretical exposure to spectroscopic characterization techniques.						

Course Outcomes	
CO1	Learners will be able to understand splitting patterns in metal complexes, and their geometries including Jahn-Teller effects
CO2	Learners will be able to interpret electronic configurations of transition metal ions using term symbols, microstates, and selection rules, and evaluation of spectral transitions
CO3	Learners will be able to evaluate the magnetic behavior of transition metal complexes and explain their magnetic properties, and predict anomalous behavior
CO4	Learners will be able to apply advanced bonding theories and analyze the structures of isopoly and heteropoly acids and salts
CO5	Learners will be able 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. 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

Activities: Assignments, quiz, discussion, presentation, etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	-	1	3	1	3	2	3	1	1	4 (Quality education)
CO2	3	-	1	-	1	3	1	3	2	3	2	1	
CO3	3	1	1	-	-	3	1	3	2	3	1	1	
CO4	3	1	1	-	-	3	1	3	3	3	2	1	
CO5	3	1	1	-	1	3	1	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 Industrial Chemistry/B.Sc. Honours Industrial 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	To deepen understanding and analysis of organic chemistry through advanced bonding concepts, reaction mechanisms, and name reactions. It integrates stereochemical principles to enhance analytical and synthetic skills.						

Course Outcomes	
CO1	Learners will be able to **explain** bonding characteristics in aromatic, non-aromatic, and antiaromatic systems, including fullerenes, annulenes, and concepts of aromaticity and homoaromaticity.
CO2	Learners will be able to **analyze** the stability and reactivity of organic reactive intermediates such as carbocations, carbanions, free radicals, carbenes, nitrenes, and benzynes.
CO3	Learners will be able to **interpret** mechanisms of organic reactions involving addition, elimination, and substitution reactions.
CO4	Learners will be able to **recognize** key named reactions, elucidate their mechanisms, and apply them to synthetic organic transformations.
CO5	Learners will be able to 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. 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/content/storage2/courses/104103071/pdf/mod8.pdf

Activities: Assignments, quiz, discussion, presentation, etc.

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

Effective from Session: 2025-26							
Course Code	B020703T/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	To describe that how gases behave under different conditions. Learners will get to study the principles of thermodynamics by understanding energy, heat, work, and entropy and how they relate to spontaneity and equilibrium in chemical systems. Learners will also study how and why chemical reactions happen at certain rates, and how temperature and other factors influence these rates. Finally, learners 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	Learners will be able to **analyze** gas behavior using ideal and real gas laws and **explain** deviations through critical phenomena and Van der Waals equations.
CO2	Learners will be able to **apply** thermodynamic laws and energy functions to **predict** spontaneity, equilibrium, and energy changes in chemical systems.
CO3	Learners will be able to **determine** reaction rates, orders, and activation energy using rate laws and theories like Arrhenius and transition state theory.
CO4	Learners will be able to **interpret** radioactive decay processes, decay modes, and half-life to **understand** nuclear stability and transformations.
CO5	Learners will be able to **analyze** photochemical kinetics and excited-state processes using photochemical laws and the Jablonski diagram.

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 criterion of spontaneity and equilibrium, Equilibrium changes 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 Photochemistry	Photosensitized reactions – energy transfer processes (simple examples), Kinetics of Photo-chemical reaction; Hydrogen-Bromine, Hydrogen-Chlorine, Decomposition of Hydrogen Iodide and kinetics of dimerization of Anthracene.	8	5

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
Activities: Assignments, quiz, discussion, presentation, etc.

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

Effective from Session: 2025-26							
Course Code	B190701T/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	To develop a comprehensive understanding 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	Learners will be able to **formulate** and **apply** key chemical principles to evaluate environmental processes and manage pollutants and radiochemical substances effectively.
CO2	Learners will be able to **integrate** and **apply** chemical principles to interpret the formation, transformation, and environmental impacts of air pollutants, reactive radicals, and photochemical reactions in various atmospheric systems.
CO3	Learners will be able to **differentiate** and **examine** physicochemical data to assess chemical parameters affecting water and soil quality, including redox reactions and nutrient cycles vital for environmental evaluation.
CO4	Learners will be able to **evaluate** and select appropriate analytical techniques—such as titrimetry, chromatography, spectrophotometry, and atomic absorption for accurate quality assessment of diverse environmental samples.
CO5	Learners will be able to **apply** national environmental quality standards and implement 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	Analytical methods in environmental quality assessment-A	Principles of commonly used analytical methods in environmental quality assessment-A: Titrimetry; Gravimetry; Colorimetry; Flame photometry; Basic Chromatography; GC; GLC, HPLC.	7	4
7	Analytical methods in environmental quality assessment-A	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. 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

Activities: Assignments, quiz, discussion, presentation, etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	-	2	-	-	3	3	3	3	3	2	3	11 (Sustainable cities and Communities)
CO2	3	-	2	1	-	3	3	2	1	2	-	3	
CO3	3	-	2	1	-	3	3	2	1	2	-	3	
CO4	3	-	-	-	2	3	-	3	3	3	3	2	
CO5	3	-	3	-	2	3	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 Industrial Chemistry/B.Sc. Honours Industrial Chemistry with Research

Effective from Session: 2025-26							
Course Code	B190702P/CH437	**Title of the Course**	Industrial Chemistry Laboratory-I	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VII	0	0	8	4
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	To develop proficiency in laboratory procedures and apply theoretical knowledge to address real-world industrial chemistry challenges, while enhancing experimental planning, execution, and scientific documentation skills.						

Course Outcomes	
CO1	Learners will be able to apply physico-chemical principles to determine viscosity, surface tension, and molecular weight of substances using standard laboratory techniques.
CO2	Learners will be able to demonstrate proficiency in separating and identifying compounds using chromatographic methods such as thin layer, paper, and column chromatography.
CO3	Learners will be able to evaluate water quality by estimating key parameters like dissolved oxygen, conductivity, total dissolved solids, and chloride content using instrumental and titrimetric methods.
CO4	Learners will be able to analyze and identify the components of binary organic mixtures using classical separation and purification techniques such as distillation and recrystallization.
CO5	Learners will be able to develop laboratory skills and good scientific practices including accurate data recording, result interpretation, and adherence to safety procedures in chemical experimentation.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Viscosity, Surface Tension, molecular weight	• To determine the percentage composition of the given mixture consisting of two • liquids A and B by viscosity method. • To determine the relative surface tension of a liquid by Stalagnometer. • To determine the molecular weight of non-volatile solute cryscopically using water as solvent.	15	1,5
2	Chromatography	• To Separate amino acid by thin layer chromatography. • To Separate mixture of carbohydrate by thin layer chromatography. • To Separate metal ion from paper chromatography • To Separate mixture of dyes by column chromatography. • To separate plant pigment from green leaves by column chromatography.	15	2,5
3	Water Quality Analysis	• To determine Dissolved Oxygen (D.O.) in the given water sample. • To determine Conductivity of the water sample. • To determine Total Dissolved Solid (T.D.S.) in the given water sample. • To determine chloride content in the given water sample. • To determine conductivity of the given water sample.	15	3,5
4	Qualitative analysis	• To separate and identify the components of binary organic mixture. • To separate binary organic mixture by fractional and vacuum distillation techniques. • To purify compounds by recrystallization Techniques.	15	4,5

Reference Books:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.
2. Practical Organic Chemistry, A.I.Vogel.
3. Experimental Inorganic Chemistry –W.G.Palmer.

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

Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												SDGs Mapping
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	1	1	3	3	3	3	3	3	3	3 (Good Health and Well-being), 4 (Quality Education) & 6 (Clean Water and Sanitation)
CO2	2	1	1	1	1	3	2	3	3	3	2	3	
CO3	3	1	1	1	1	3	3	3	3	3	3	3	
CO4	3	1	1	1	1	2	3	2	3	2	2	3	
CO5	2	1	1	1	1	2	2	3	3	3	3	2	

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

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

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

Effective from Session: 2025-26							
Course Code	B190703R/CH436	**Title of the Course**	Industrial 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	Learners will be able to demonstrate the ability to conduct independent literature reviews to identify relevant research gaps and design appropriate experimental approaches in industrial chemistry.
CO2	Learners will be able to carry out experimental procedures for the synthesis or analysis of chemical compounds using standard laboratory practices and safety protocols.
CO3	Learners will be able to apply appropriate analytical and characterization techniques (such as FTIR, UV-Vis, GC, or XRD) to evaluate the physicochemical properties of synthesized compounds.
CO4	Learners will be able to analyze and interpret experimental data effectively to draw valid conclusions that support the research objectives.
CO5	Learners will be able to repare 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	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	-	-	2	1	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	1	1	1	
CO3	2	3	1	2	1	1	2	2	1	1	1	3	
CO4	1	3	2	2	1	-	-	1	2	2	2	1	
CO5	1	2	1	-	1	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 Industrial 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.	B190801T/CH439	Dyes, Paints, Pigments & Oleo Chemicals	T	Core Major	05	01	00	15	10	25	75	100	04	√		√					
2.	B190802T/CH440	Petrochemicals and Agrochemicals	T		05	01	00	15	10	25	75	100	04	√		√		√			
3.	B190803T/CH441	Quality Control, Chemical Safety & Industrial Hygiene Measures	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.	B190805P/CH443	Industrial 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 Industrial 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.	B190801T/CH439	Dyes, Paints, Pigments & Oleo Chemicals	T	Core Major	05	01	00	15	10	25	75	100	04	√		√					
2.	B190802T/CH440	Petrochemicals and Agrochemicals	T		05	01	00	15	10	25	75	100	04	√		√		√			
3.	B190803T/CH441 Or B190804T/CH442	Quality Control, Chemical Safety & Industrial Hygiene Measures Or Advanced Analytical Techniques	T	Elective	05	01	00	15	10	25	75	100	04	√	√	√		√	√	√	
PRACTICALS																					
4.	B190805P/CH443	Industrial Chemistry Laboratory-II	P	Core Major	00	00	04	15	10	25	75	100	04	√		√					
5.	B190806R/CH444	Industrial Chemistry Research Project-4	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 Industrial Chemistry/B.Sc. Honours Industrial Chemistry with Research

Effective from Session: 2025-26							
Course Code	B190801T/CH439	**Title of the Course**	Dyes, Paints, Pigments & Oleo Chemicals	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	To provide a comprehensive understanding of these materials, their properties, applications, and interactions within various industries.						

Course Outcomes	
CO1	Learners will be able to **analyze** the structural diversity and historical development of dyes and **assess** their applicability
CO2	Learners will be able to **understand** the types of dyes and their synthesis will be able to **develop** safer alternatives and **plan** remediation strategies.
CO3	Learners will be able to **illustrate** different types of paints and pigments and **justify** their use, with accurate explanation
CO4	Learners will be able to **understand** pigments, their types and synthesis, will be able to **determine** the selection and application of specialized pigments for specific functional outcomes.
CO5	Learners will be able to **evaluate** the synthesis routes and applications of oleochemicals **to assess** their feasibility in industrial practices.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Dyes Introduction and Classification	Introduction of the History of Dyes. Landmarks in the historical development from Natural to synthetic dyes. Chemistry of the dyes with respect to general structural features; Chromophore, Auxochrome. Classification of dyes based on structure and the mode of application to the fibre.	6	1
2	Dyes Synthesis and application	Synthesis and application of Alizarin, Alizarin Orange, Methyl Orange, Aniline yellow, Butter yellow, Eriochrome Black-T, Phenolphthalein, Methylene blue, Indigo, Malachite green.	8	2
3	Dyeing & remediation process	Methods of dyeing, Basic operations in dyeing, Difference between pigment and dye. Health and Environmental Hazards of Synthetic Dyes and their Remediation processes	8	2
4	Paints: Classification and Composition	Introduction to paint, ingredient and classification. General classification of surface coatings, mechanism of film formation, sources and composition of oils, non–glyceride, components of oils, extraction and refining of oils.	8	3
5	Paints Types, Testing and Evaluation	Paint making; Mechanism of film formation; Modern Surface Coatings; Properties of Surface Coatings and their films; Sealers, fillers, undercoats, topcoats. Special paints Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint. Testing and evaluation tests of liquids films, dry films, performance and weathering test,	8	3
6	Pigment Classification and Testing	Classification of pigments, Natural organic pigments, comparison of organic pigments and inorganic pigments General method of preparation and classification of synthetic organic pigment. Basic and acid dye pigment testing of pigments, oil absorption value, bulking value, sp. Gravity, refractive index, reducing power, tinting strength, resistance to heat.	8	4
7	Pigments, preparation and properties	Introduction to pigments, general and physical properties of paints and pigments; Preparation, properties and uses of Black pigment (Carbon black), Yellow pigment (chrome yellow), Red pigment (Red lead), Green pigment (Chrome green), White pigment (ZnO), Blue pigment (Ultramarine blue).	8	4
8	Oleochemicals	Oleochemicals as raw materials and their derivatives as feedstock for Chemical Industries, Different techniques of synthesis of Fatty Acid Methyl Esters (FAME), Glycerol and Fatty Alcohols, Fatty Amines, Amides, and Nitriles	6	5

Reference Books:

1. The Chemistry of Oils and Fats: Sources, Composition, Properties and Uses, Frank D. Gunstone, Blackwell Publishing Ltd, UK (2004).
2. Bailey's Industrial Oil and Fat Products, Sixth Edition Vol. 1: Edible Oil and Fat Products: Chemistry, Properties, and Health Effects, Ed. FereidoonShahidi, John Wiley & Sons, Inc., Wiley Interscience Publication (2005)
3. Outlines of Paint Technology By -W.M.Morgans Publisher Edward Arnold
4. Paint and Coating Testing Manual By- Joshep V. Koleske Publishur ASTM International
5. Pigment Handbook vol-1 By T.C.Patton

e-Learning Source:

1. https://www.youtube.com/watch?v=BRdxdB2r3hY
2. http://kcl.digimat.in/nptel/courses/video/116102052/lec3.pdf
3. http://elearn.psgcas.ac.in/nptel/courses/video/103103218/lec29.pdf
4. https://www.youtube.com/watch?v=hDn9K1XAiiM
5. https://www.youtube.com/watch?v=BRdxdB2r3hY

Activities: Assignments, quiz, discussion, presentation, etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	-	-	-	-	1	2	3	2	3	1	2	3 (Good Health and Well-being), 9 (Industry, Innovation, and Infrastructure), 12 (Responsible Consumption and Production) & 13 (Climate Action)
CO2	3	-	-	-	-	2	2	3	2	2	1	2	
CO3	3	-	-	-	-	1	2	3	3	1	1	2	
CO4	3	-	-	-	-	1	2	3	3	2	1	2	
CO5	3	-	-	-	-	1	2	3	2	2	1	1	

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

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

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

Effective from Session: 2025-26							
Course Code	B190802T/CH440	**Title of the Course**	Petrochemicals and Agrochemicals	**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 comprehensive understanding of the origin, processing, and refining of petroleum and petrochemicals, along with the synthesis and applications of pesticides including insecticides, fungicides, herbicides, and molluscicides. It emphasizes industrial processes, purification methods, and the chemical basis of agrochemicals, integrating theory with real-world applications.						

Course Outcomes	
CO1	Learners will be able to understand petroleum origin, exploration, and processing. Students will formulate and apply refining techniques, including crude oil distillation, desalting, and treatment methods, to evaluate fuel quality and product specifications.
CO2	Learners will be able to understand and evaluate the advanced petroleum processing, students will explore fuel types, purification techniques, cracking methods, synthetic fuel production, and petrochemical synthesis to evaluate refining efficiency and environmental impact.
CO3	Learners will be able to analyze the structural and functional diversity of pesticides, students will explain the classification, synthesis, SAR, mode of action, and formulation of major insecticides to understand their application in pest control.
CO4	Learners will be able to understand and explore the chemistry, classification, and mechanisms of action of key fungicides including inorganic compounds, dithiocarbamates, quinones, antibiotics, and benzimidazoles relevant to agricultural and industrial use.
CO5	Learners will be able to evaluate herbicides and molluscicides, also able to explain their synthesis, applications, and mechanisms of action.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Petroleum	Introduction, origin of petroleum in nature, carbide theory, anglers theory, modern views; Petroleum exploration in India and their resources; crude oil, natural gas; composition of petroleum; preparation of crude for processing; destruction of natural emulsion of petroleum crude, desalting.	8	1
2	Methods of Petroleum distillation	Fundamentals of preliminary distillation; Methods of petroleum distillation; Distillation of crude petroleum; Treatment of the residual liquid; Processing of liquid fuels such as petroleum and petroleum products; Product profile of refinery distillations and their specification.	8	1
3	Classification of Liquefied hydrocarbon gases and fuels	Introduction and classification of Liquefied hydrocarbon gases and fuels; Fuels for jet engines and gas turbine engines; Dye intermediates, Lacquers, Solvent and thinner Absorptive and adsorptive purification, Sulphuric acid purification, alkaline purification, Hydrofining, New method of purification, demercaptanisation, Stabilization.	7	2
4	Petroleum Refining, Cracking, and Lubricating oils	Introduction of petroleum refining, cracking, application of cracking, synthetic petrol, Bergius process, Fischer-Tropsh process, octane number, flash point, determination of flash point, synthesis of pure chemicals from petrochemicals. Lubricating oils and additives, fuel quality aspects and environment aspects, Case study of Naphtha crakers and their product profile.	7	2
5	Organochlorines and Carbamates Insecticides	General Introduction and concept of pesticides, Classification of Insecticides, synthesis, structure activity relationship, mode of action, uses and formulation of following insecticides: Organochlorines: Heptachlor, Chlordane and endosulfan; Carbamates: Phenyl carbamates (Bendiocarb & Baygon), N-Methylcarbamates(Zectran, Isolan), Oxime carbamates (Oxamil, Methyomyl)	8	3
6	Organophosphorus Insecticides	Synthesis, structure activity relationship, mode of action, uses and formulation of following Insecticides: Organophosphorous: parathion, malathion, dichlorvos, phosdrin, monocrotophos, dicrotophos, fenitrothion, fenthion, chlorpyriphos & phosalone.	8	3
7	Fungicides	Chemistry and applications of following fungicides: Inorganic; sulfur, copper-oxychloride and organomercurials; Ceresan M, Phenyl mercury acetate Dithiocarbamates; Metham, Nabam, mancozeb Quinones; chloranil. Antibiotics; kasugamycin and griseofulvin. Benzimidazole; carbendazim, thiabendazole.	7	4
8	Herbicides	Herbicides and Molluscicides, Synthesis and uses of following: Aromatic Acid compounds; 2, 4-D, 2, 4, 5-T. N, N-dimethylureas; monuron and diuron Anilides; alachlor and butachlor, sulfonylureas; Chlorsulfuron, Metsulfuron methyl, Sulphometuron. Molluscides: metaldehyde and carbamates;Methiocarb.	7	5

Reference Books:

1. Fuels and Combustion, Samir Sarkar, 2nd.Edition, Orient Longmans (1990) Mumbai; Modern Petroleum refining process, B.K. Bharbana Rao,
2. Petroleum chemistry and refining, James g. Speight, Taylor and francis publishers; Fuel technology by Wilfrid Francis and M.C.Peters. Plenum press (1981).
3. Principles of pesticide chemistry by S.K. Handa; K.H. Bechel: Chemistry of pesticides
4. Chemistry of Pesticide bt N. K. Roy; H.B. scher: Advances in pesticides, formulation technology

e-Learning Source:

1. https://byjus.com/chemistry/petroleum/
2. https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf
3. https://www.shell.com/energy-and-innovation/natural-gas/liquefied-natural-gas-lng.html

Activities: Assignments, quiz, discussion, presentation, etc.

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

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

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

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

Effective from Session: 2025-26							
Course Code	B190803TCH441	**Title of the Course**	Quality Control, Chemical Safety & Industrial Hygiene Measures	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	5	1	0	4
Pre-Requisite	B.Sc. with Chemistry	**Co-requisite**	-				
Course Objectives	To equip students with the knowledge of quality management systems, occupational health and safety standards, and industrial hazard control, including risk assessment, training strategies, radiation and chemical safety, and the impact of industrial pollutants on human health.						

Course Outcomes	
CO1	Learners will be able to **explain** the quality systems such as ISO 9000 and TQM, which would enable them to **evaluate** and **apply** tools to enhance process performance.
CO2	Learners will be able to **understand** the structure, benefits, and certification process of OHSAS 18001, which would enable them to **determine** the occupational health and safety policies in achieving strategic objectives.
CO3	Learners will be able to **analyze** air and biological monitoring, control measures, and make them **understand** their role in preventing occupational diseases and ensuring workplace safety.
CO4	Learners will be able to **determine** the training strategies and health hazard management, which would enable them to **design** workplace safety strategies, stress, and organizational safety responsibilities.
CO5	Learners will be able to **assess** the health impacts of industrial pollutants, which would enable them to **develop** effective strategies to mitigate the pollutant effects on human health.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Quality Control and Safety Standards	Quality objectives – Quality control – Quality Assurance – Process variability, ISO 9000 and TQM concepts - Quality circles, tools – Zero defect management, 6 sigma – Quality Function Deployment (QFD).	7	1
2	OHSAS standard-II	Introduction – Development of OHSAS standard – Structure and features of OHSAS 18001 and Benefits of certification-certification procedure – OH and S management system element	7	2
3	OHSAS standard - II	Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology	8	2
4	Industrial hygiene	Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments	7	3
5	Occupational Health and Environmental Safety Education	Element of the training cycle, Assessment of needs.Techniques of training, design, and development of training programs.Training methods and strategies: types of training.Evaluation and review of training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit	8	4
6	Safety and Health Management	Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Importance of Industrial safety, role of safety department, Safety committee, and Function.	8	4
7	Chemical Hazards	Classification of hazardous chemicals, storage, transportation, handling, risk assessments, challenges, and solutions.	7	5
8	Radiation and Industrial Hazards	Types and effects of radiation on human body, Measurement and detection of radiation intensity, Effects of radiation on human body, Measurement –disposal of radioactive waste, Control of radiation. Different air pollutants in industries: Effect of different gases and particulate matter, acid fumes, smoke, fog, and their effects on human health.	8	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://www.osha.gov/Publications/OSHA3143/OSHA3143.html
2. https://nptel.ac.in/courses/114106017/
3. https://www.academia.edu/38181906/Safety and health management and organizational productivity edited.pdf
4. https://www.egyankosh.ac.in/bitstream/123456789/10786/1/Unit-3.pdf

Activities: Assignments, quiz, discussion, presentation, etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	1	2	3	3	2	3	2	1	1	4 (Quality Education) & 9 (Industry, Innovation, and Infrastructure)
CO2	2	2	3	1	2	2	3	1	3	2	1	1	
CO3	2	2	3	1	2	2	3	2	3	2	1	1	
CO4	2	2	3	2	2	2	3	1	3	2	2	2	
CO5	2	2	3	2	3	2	3	2	3	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 Industrial Chemistry/B.Sc. Honours Industrial 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	To understand and develop a comprehensive knowledge of 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	Learners will be able to **analyze** and **interpret** UV-Vis, IR, NMR, and MS spectra to elucidate and design molecular structures and functional groups.
CO2	Learners will be able to **evaluate** AAS and ICP-MS data to quantify trace elements and heavy metals through flame and plasma atomization techniques.
CO3	Learners will be able to **interpret** TGA, DTA, and DSC thermograms to characterize decomposition, phase transitions, and thermal stability of materials.
CO4	Learners will be able to **apply** advanced chromatographic techniques (UPLC, LC-MS, GC-MS) to resolve and develop methods for complex chemical matrices.
CO5	Learners will be able to **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 (NOSY, COSY)	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

Activities: Assignments, quiz, discussion, predestination etc.

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

Effective from Session: 2025-26							
Course Code	B190805P/CH443	**Title of the Course**	Industrial Chemistry Laboratory-II	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	0	0	8	4
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	To build laboratory proficiency and apply practical knowledge to industrial chemistry challenges, while strengthening experimental planning and scientific reporting skills.						

Course Outcomes	
CO1	Learners will be able to **apply** quantitative and qualitative methods to determine physicochemical properties.
CO2	Learners will be able to **demonstrate** proficiency in synthesizing and analyzing pharmaceutical and dye compounds.
CO3	Learners will be able to **evaluate** environmental and industrial aspects of agrochemicals.
CO4	Learners will be able to **interpret** the physical and chemical behavior of petrochemical products.
CO5	Learners will be able to **develop** laboratory techniques and critical analysis skills by performing experiments.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Analysis of Oils	• To determine saponification value in the given oil. • To determine acid value in the given oil. • To determine Iodine value in the given oil. • To separate essential oils by soxhlet extractor.	15	1,5
2	Synthesis of medicinally relevant compounds	• To synthesize and report the yield of Aspirin. • To prepare and report the yield of chalcone (Benzylidene acetophenone). • To synthesize and report the yield of Paracetamol. • To prepare and report the yield of dibenzyl acetone from acetone and benzaldehyde	15	2,5
3	Analysis of Dyes	• To determine pH and conductivity of dye bath. • To remove excess dye from effluent using flocculation/precipitation. • To analyze azo group stability in acidic/basic medium by titration. • To determine Viscosity of Lubricating Oil.	15	3,5
4	Agrochemicals	• To synthesize Dichlorodiphenyl trichloroethane (DDT). • To estimate Residual Pesticides in Fruits/Vegetables. • To synthesize and evaluate simple agrochemicals like urea or Bordeaux mixture. • To determine Flash Point and Fire Point of Petroleum Products.	15	4,5

Reference Books:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.
2. Laboratory Manual in Organic Chemistry – R. K. Bansal
3. Practical Organic Chemistry, A.I.Vogel.
4. Vogel's Textbook of Practical Organic Chemistry – B.S. Furniss et al
5. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis – V. K. Ahluwalia & Renu Aggarwal

e-Learning Source:

1. https://www.youtube.com/user/nptelhrd
2. https://ocw.mit.edu
3. https://edu.rsc.org/resources

Activities: Assignments, quiz, discussion, presentation, viva-voce, lab manual preparation, group exercise etc.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	1	1	2	3	3	3	2	3	3	3 (Good Health and Well-being), 4 (Quality Education), 9 (Industry, Innovation, and Infrastructure) & 11 (Sustainable Cities and Communities)
CO2	3	1	1	1	1	3	2	3	3	2	2	3	
CO3	3	1	1	1	1	2	2	3	2	2	3	3	
CO4	3	1	1	1	1	3	2	3	3	2	3	3	
CO5	3	1	1	1	1	3	2	3	3	2	3	2	

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

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

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

Effective from Session: 2025-26							
Course Code	B190806R/CH444	**Title of the Course**	Industrial 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	Learners will be able to demonstrate the ability to conduct independent literature reviews to identify relevant research gaps and design appropriate experimental approaches in industrial chemistry.
CO2	Learners will be able to carry out experimental procedures for the synthesis or analysis of chemical compounds using standard laboratory practices and safety protocols.
CO3	Learners will be able to apply appropriate analytical and characterization techniques (such as FTIR, UV-Vis, GC, or XRD) to evaluate the physicochemical properties of synthesized compounds.
CO4	Learners will be able to analyze and interpret experimental data effectively to draw valid conclusions that support the research objectives.
CO5	Learners will be able to 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	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	-	-	2	1	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	1	1	1	
CO3	2	3	1	2	1	1	2	2	1	1	1	3	
CO4	1	3	2	2	1	-	-	1	2	2	2	1	
CO5	1	2	1	-	1	2	2	-	2	1	-	3	

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

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