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 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

	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	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 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	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

	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	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 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	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 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	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 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	4	2
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	To develop practical and technical skills for better understanding of theory. To develop transferrable skills and enhancing communication skills of students.						

Course Outcomes	
CO1	Apply physico-chemical principles to determine viscosity, surface tension, and molecular weight of substances using standard laboratory techniques.
CO2	Demonstrate proficiency in separating and identifying compounds using chromatographic methods such as thin layer, paper, and column chromatography.
CO3	Evaluate water quality by estimating key parameters like dissolved oxygen, conductivity, total dissolved solids, and chloride content using instrumental and titrimetric methods.
CO4	Analyze and identify the components of binary organic mixtures using classical separation and purification techniques such as distillation and recrystallization.
CO5	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	1,2
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	2,3
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 chloride content in the given water sample. • To determine conductivity of the given water sample.	15	3,4
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

	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	2	2	2	3	2	2	1	3 (Good Health and Well-being), 4 (Quality Education) & 6 (Clean Water and Sanitation)
CO2	3	2			1	2	2	2	1	3	3	2	1	
CO3	3	1	2		1	3	3	3	1	3	3	3	1	
CO4	3	1			2	2	1	2	2	3	2	2	1	
CO5	2	3	1	2	3	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	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 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	The objective of a course on paints, pigments, and oleochemicals is to provide a comprehensive understanding of these materials, their properties, applications, and interactions within various industries.						

Course Outcomes	
CO1	Understand and illustrate the technical significance of oleo-chemical.
CO2	Analyze and evaluate physical characteristics of oleochemicals.
CO3	Describe the ingredients and characteristics of paint. Evaluate the properties (adhesion, hardness, thickness, extent of cure, etc.) of the cured film. Will be familiar with the composition of paints and coatings and modern technologies used in the preparation of paint/coatings formulations.
CO4	Comprehension of properties, constituents and formulations of pigments and dyes, differentiate dyes and pigments, their mechanisms of action and applications.
CO5	Comprehensive understanding of properties, constituents, formulations and uses of pigments, varnishes etc. Develop an appropriate choice of coating material (paint, pigment, dye or varnish) based on the nature of the substrate. The course aims to equip individuals with the knowledge and skills necessary for careers in related fields, such as paint manufacturing, pigment production, oleochemical processing.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Oleochemicals	Oleochemicals raw materials and their derivatives as feedstock for Chemical Industries, Worldwide Statistics of Oleochemical, Different techniques of synthesis of Fatty Acid Methyl Esters (FAME), Glycerol and Fatty Alcohols, Fatty Amines, Amides, and Nitriles	8	1
2	Classification and Processing of Oils	Classification of non-drying, semi drying and drying oils. Processing of semidrying and drying oils. Acid refining, oxidative and thermal polymerization of oils and its mechanisms	8	2
3	Surface Active Phenomena of Oils	Different surface activity phenomenon: Emulsification & de-emulsification, foaming & defoaming, Solubilization, Dispersion, Wetting, Detergency	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.	6	3
5	Testing, Evaluation, and Types of Coatings	Testing and evaluation tests of liquids films, dry films, performance and weathering test, world standard specification for paints and materials. Paint making; Mechanism of film formation; Modern Surface Coatings; Properties of Surface Coatings and their films; Sealers, fillers, undercoats, topcoats. Convertible and non-convertible coatings.	6	3
6	Pigment Characterization in Surface Coatings	Concept of colour phenomena, classification of pigments, testing of pigments, oil absorption value, bulking value, sp. Gravity, refractive index, mass tone, reducing power, tinting strength, resistance to heat.	8	4
7	Pigments, preparation and properties	Introduction to pigments, general and physical properties of paints pigments and varnishes; 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); Properties of Coating, solvent plasticizers Dyes	8	4
8	Dyes	Methods of dyeing, Basic operations in dyeing, Study of Phenolphthalein, Methyl orange and Crystal violet. Difference between pigment and dye.	8	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. Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall

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

	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	2	2	3	2	3	2	1	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	2	2	2	2	3	2	2	1	2	
CO3	3	3	2	3	2	2	2	3	3	3	2	2	
CO4	3	2	3	2	2	3	2	3	3	2	2	3	
CO5	3	2	2	2	2	3	2	3	2	2	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	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	This course introduces 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	For understanding 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	For 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	Given the structural and functional diversity of pesticides, students will investigate the classification, synthesis, SAR, mode of action, and formulation of major insecticides including organochlorines, carbamates, and organophosphates to understand their application in pest control.
CO4	For effective understanding and application, students will 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	Given key herbicides and molluscicides, students will be 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, Oxford and IBHpublication.
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
5. Fuels and Combustion, Samir Sarkar, 2nd.Edition, Orient Longmans (1990) Mumbai.
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
4. https://www.e-education.psu.edu/fsc432/content/lesson-7-overview
5. https://www.youtube.com/watch?v=p32vHoW8Awk

	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	2	1	3	3	3	2	3	2	4 (Quality Education) & 9 (Industry, Innovation, and Infrastructure)
CO2	3	-	2	2	2	2	3	3	3	3	2	3	2	
CO3	3	-	2	2	1	2	1	3	3	3	2	3	2	
CO4	3	-	1	1	1	2	2	3	3	3	2	3	2	
CO5	3	-	2	2	2	2	2	3	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	B190804T/CH441	**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	Interpret quality systems like ISO 9000 and TQM, and assess the effectiveness of tools like Six Sigma, QFD, and zero-defect strategies in improving process performance.
CO2	Evaluate the structure, benefits, and certification process of OHSAS 18001, and assess the effectiveness of occupational health and safety policies in meeting strategic goals and regulatory compliance.
CO3	Assess the role of air and biological monitoring, control measures, and personal protective equipment in preventing occupational diseases and maintaining workplace safety.
CO4	Evaluate training strategies for workplace safety and create programs to manage health hazards, stress, and organizational safety roles.
CO5	Assess the health impacts of industrial radiation and air pollutants, and create effective strategies for radiation control, waste disposal, and mitigation of 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	7	2
4	Industrial hygiene	Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments	8	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 on human health.	8	5

Reference Books:

1. Jeanne MagerStellman, Encyclopedia of Occupational Health and Safety (ILO) Ms. Irma Jourdan publication
2. Kletz Hazop and Hazan-Ref to cheme, Macmillan Education Australia
3. Handbook of OSHA Construction safety and health charles D. Reese and James V. Edison
4. Industrial Safety –National Safety Council of India
5. R.K. Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)

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
5. https://www.nqa.com/en-in/certification/standards/ohsas-18001

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												**SDGs Mapping**
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	

CO														
CO1	3	2	2	2	2	2	2	2	3	3	2	2	2	3 (Good Health and Well-being) & 8 (Decent Work and Economic Growth)
CO2	3	-	3	3	2	2	2	2	3	2	2	3	3	
CO3	3	-	3	2	2	3	2	2	2	2	3	3	3	
CO4	3	-	3	3	2	3	2	2	2	2	3	3	3	
CO5	3	-	2	3	1	3	2	2	3	2	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	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 Infrastructure)
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	

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	4	2
Pre-Requisite	BSc. with Chemistry	**Co-requisite**	-				
Course Objectives	To develop practical and technical skills for better understanding of theory. To develop transferrable skills and enhancing communication skills of students						

Course Outcomes	
CO1	Apply quantitative and qualitative methods to determine physicochemical properties.
CO2	Demonstrate proficiency in synthesizing and analyzing pharmaceutical and dye compounds.
CO3	Evaluate environmental and industrial aspects of agrochemicals.
CO4	Interpret the physical and chemical behavior of petrochemical products.
CO5	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

	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	3	-	2	-	-	3 (Good Health and Well-being), 4 (Quality Education), 9 (Industry, Innovation, and Infrastructure) & 11 (Sustainable Cities and Communities)
CO2	3	-	-	2	3	-	-	3	3	-	2	2	-	
CO3	3	-	2	-	3	2	-	3	3	2	2	-	-	
CO4	3	-	-	-	3	2	-	3	3	-	2	-	-	
CO5	3	3	-	2	3	-	-	3	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 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	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**