Effective from Session: 2024-25							
Course Code	B020501T/CH337	**Title of the Course**	Organic Synthesis-A	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	3	1	0	4
Pre-Requisite	Diploma	**Co-requisite**	-				
Course Objectives	The main objective of this course is to provide key knowledge of hydrocarbons, which are the principal constituents of petroleum and natural gas. They serve as fuels and lubricants as well as raw materials for the production of plastics, fibres, rubbers, solvents, and industrial chemicals. This course will provide a broad foundation for the synthesis of hydrocarbons. Alcohols and carbonyl compounds are industrially important compounds. The industries of plastics, fibres, petroleum, and rubber will especially recognize this course.						

Course Outcomes	
CO1	Students would be able to remember and analyse the synthesis, chemical properties, and reactions of aliphatic hydrocarbons.
CO2	Students would be able to evaluate the physical and chemical properties of aromatic hydrocarbons and their chemical reactions.
CO3	Students would be able to understand and comprehend the chemistry of alcohols and phenols.
CO4	Students would perceive the sound knowledge of methods of their formation, physical properties, and chemical reactions of ethers and epoxides.
CO5	Students will be able to understand and rate the formation processes, chemical reactions, and mechanisms of nucleophilic substitution reactions of alkyl halides, as well as SN^2 and SN^1 reactions with energy profiles and the making of different pesticides.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chemistry of Alkanes and Cycloalkanes	A) Alkanes: Classification of carbon atom in alkanes, General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity B) Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Chair, Boat and Twist boat forms of cyclohexane with energy diagrams ring strain in small rings, theory of strain less rings. The case of cyclopropane ring, banana bonds	8	1
2	Chemistry of Alkenes	Methods of formation of alkenes, Addition to C=C: mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenation, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, epoxidation, syn and anti-hydroxylation, ozonolysis, addition of singlet and triplet carbenes; Simmons-Smith cyclopropanation reaction; electrophilic 12 35 addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of NBS; interconversion of E- and Z-alkenes	12	1
3	Chemistry of Alkynes	Methods of formation of alkynes, Addition to C≡C, mechanism, reactivity, regioselectivity and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and non-terminal alkynes	6	1
4	Aromaticity and Chemistry of Arenes	Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism. Directing effects of the groups. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and anthracene.	10	2
5	Chemistry of Alcohol	Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacol pinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol	8	3
6	Chemistry of Phenols	Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, Hauben Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reactio	6	3
7	Chemistry of Ethers and Epoxides	Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.	5	4
8	Chemistry of Organic Halides	Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2and SN1 reactions with energy profile diagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination- addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides,	5	5

Reference Books:

Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, Second edition, Oxford Publication.

Organic Chemistry by T.W.Graham Solomons, and Craig B. Fryhle, Ninth edition, Wiley Publication.

Organic Chemistry by IL Finar, Volume 1 & 2, Sixth edition, Pearson Publication
Advanced Organic Chemistry (Reactions, Mechanisms and Structure): Michel B. Smith and Jerry March, 4th Edition, Wiley Interscience Publication.
A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Six edition, Pearson publication.
Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition,
Mukeherji, Singh, Kapoor, Organic Chemistry , Vol 1, New Age International 2014
Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International.
Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing 13. TN SRIVAS
e-Learning Source:
http://heecontent.upsdc.gov.in/Home.aspx
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
https://nptel.ac.in/courses/104/106/104106096/

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

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

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

SDGs -9

Effective from Session: 2024-2025							
Course Code	B020502T/CH338	**Title of the Course**	Rearrangements and Chemistry of Group Elements	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	3	1	0	4
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	The primary goal of this course is to impart a thorough understanding of significant rearrangement reactions in the field of organic chemistry. In addition, the student will receive a concise explanation of the concept of catalysis, along with pertinent examples. The text also discusses the chemistry of several elements and provides a comprehensive comprehension of the s, p, d, and f block elements and their significant attributes. Additionally, this text will provide detailed explanations of the applications of several significant inorganic chemicals.						

Course Outcomes	
CO1	The learner will be able to understand some important rearrangement reactions in organic chemistry, along with their mechanistic insights and factors affecting the rate of the reaction.
CO2	The learner will be able to remember and understand the concept of catalysis, the effects of homo and hetero catalysts, and how they impact the overall rate of the reactions. Along with that, the concept of enzymatic catalysis will also be introduced.
CO3	The learner will have a thorough understanding and evaluation of the modern periodic table and different periodic properties. The characteristics of group 1 and 2 elements will also be elaborated. The learner will also be taught the characteristics of P block elements, including groups 13–18. The anomalous properties of the first element of each group and the diagonal relationship will also be elucidated. A comprehension of the properties of inert gases will also be done. The chemistry of some important inorganic compounds will also be discussed.
CO4	The learner will have a comprehensive understanding and analyze the characteristics of d and f block elements, and an insight into important phenomena like lanthanide contraction and its consequences will also be elucidated. The chemistry of some important compounds of d and f block elements will also be discussed.
CO5	The learner will be able to understand and evaluate the concept of bioinorganic chemistry. The importance of essential and trace elements will also be discussed, along with their deficiency diseases. The biological role of alkali and alkaline elements will also be elaborated, and the physiological functioning of important biomolecules like haemoglobin and myoglobin will also be discussed.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Rearrangement reactions in Organic Chemistry	Mechanistic insights of the following rearrangements: Pinacol-pinacolone, Demjanov, Benzil Bensilic acid, Favorskii, Hoffman, Curtius, Schmidt, Baeyer-Villiger and Fries rearrangement.	8	1
2	Catalysis in Organic Chemistry	General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation, or regeneration of catalysts. Phase transfer catalysts, Enzyme catalysis; Michaelis-Menten equation, turn-over number.	8	2
3	Periodic properties and Chemistry of s block elements	Modern periodic table and trends in properties like atomic and ionic radii, ionization energy, electron affinity, electronegativity, and chemical reactivity. Group - 1 and 2 Elements General introduction, electronic configuration, and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group and diagonal relationship.	8	2
4	Chemistry of p block elements	General Introduction: Electronic configuration and general trends in physical and chemical properties of elements anomalous properties of the first element of each group and diagonal relationship. Chemistry of inert gases.	8	3
5	Chemistry of some important compounds	Chemistry of some important compounds like boranes, interhalogens, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride	6	3
6	Chemistry of d block elements	General introduction, electronic configuration, and characteristics including ionization energy, oxidation states, atomic radii, colour, catalytic behaviour, and magnetic properties. Preparation, properties, and uses of $K_2Cr_2O_7$ and $KMnO_4$.	8	4
7	Chemistry of f block elements	Lanthanides and actinides: General introduction, electronic configuration, and characteristics including ionization energy, oxidation states, atomic radii, colour, and magnetic properties. Lanthanide contraction and its consequences. Preparation, properties and uses of ceric ammonium sulphate	8	4
8	Role of inorganic elements in biology	Essential and trace elements: their role in biological systems, deficiency diseases and toxicity. Synergistic and antagonistic effect. Metalloporphyrins with special reference to heamoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions.	6	5

Reference Books:

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.

Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010

Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.

Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962

R.D.Madan, Principles of Inorganic Chemistry, S CHAND PUBLISHERS

Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.

Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.

Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.

Mukeherji, Singh, Kapoor, Organic Chemistry, Vol 1, New Age International 2014

e-Learning Source:

http://heecontent.upsdc.gov.in/Home.aspx

https://nptel.ac.in/courses/104/106/104106096/

http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/106/104106096/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

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

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

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

SDG 4, 8

Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	B190503P/CH339	**Title of the Course**	Quantitative Analysis	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	The main objective of this course is to deliver essential knowledge of laboratory techniques for the analysis of inorganic salts, the identification of functional groups, and the separation of organic mixtures.						

Course Outcomes	
CO1	Students would be able to understand the laboratory methods and tests related to inorganic mixtures and organic compounds.
CO2	Students would be able to identify acids and basic radicals in an inorganic mixture.
CO3	Students would be able to perform and analyse the separation of organic compounds from mixtures.
CO4	Students would be able to understand the elemental analysis of organic compounds.
CO5	Students would be able to identify and analyse functional groups in organic compounds and identify organic compounds.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Inorganic Qualitative Analysis	Semi micro-Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3	16	1,2
2	Elemental analysis and identification of functional groups	Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.	14	2,3
3	Separation of Organic Mixture	Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, NaOH for separation and purification of suitable derivatives	10	2,4
4	Identification of organic compounds	Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives. Identification of the organic compounds by IR and NMR Spectroscopy. (Photocopies of the spectra to be provided to the students)	20	2,5

Reference Books:

Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of practical organic chemistry prentice Hall, 5th edition, 1996

Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960

Harris, D.C.Exploring Chemical Analysis, 9thEd. New York, W.H. Freeman, 2016

Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009. Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

e-Learning Source:

https://www.labster.com/chemistry-virtual-labs/

https://www.vlab.co.in/broad-area-chemical-sciences

http://chemcollective.org/vlabs

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

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

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

SDG 4

Effective from Session: 2024-25							
Course Code	B020504R/CH340	**Title of the Course**	Chemistry Research Project-1	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	0	0	10	5
Pre-Requisite	Diploma	**Co-requisite**	-				
Course Objectives	To provide the industrial exposure and enhance technical skills of students						

Course Outcomes	
CO1	Hands on training
CO2	Integrate classroom theory with laboratory practice.
CO3	Understanding professional ethics of industry and code of conduct.
CO4	Essential training in laboratory safety procedures
CO5	Compilation of data and report writing

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

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

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

Effective from Session: 2024-2025							
Course Code	B020601T/CH353	**Title of the Course**	Organic Synthesis B	**L**	**T**	**P**	**C**
Year	Three	**Semester**	Six	3	1	0	4
Pre-Requisite	Diploma	**Co-requisite**	-				
Course Objectives	This paper provides detailed knowledge of the synthesis of various classes of organic compounds and functional groups through interconversion. Organic synthesis is the most important branch of organic chemistry, which provides jobs in production and QC departments related to chemicals, drugs, medicines, FMCG, etc. industries. The study of natural products and heterocyclic compounds offers an excellent strategy towards identifying novel biological probes for several diseases. Historically, natural products have played an important role in the development of pharmaceutical drugs for a few diseases, including cancer and infection.						

Course Outcomes	
CO1	Students would perceive the sound knowledge of various reagents for oxidation and reduction in organic synthesis. And understand organomagnesium, organozinc, and organolithium compounds, including their formation and diverse chemical reactions.
CO2	Students will develop a comprehensive knowledge of aldehydes, ketones, and carboxylic acids. Learn how to name them, make them, what their physical properties are, and how they react to different things. For example, learn how nucleophilic additions work and how to make functional derivative preparations. Achieve proficiency in organic synthesis.
CO3	Students will develop the knowledge necessary for a proficient understanding of organic synthesis via enolates and the organic chemistry of nitrogen-containing compounds.
CO4	Students would perceive the sound knowledge and comprehensive understanding of heterocyclic molecular structures, synthesis, reactions, and substitution mechanisms.
CO5	Students will develop a comprehensive understanding of alkaloids and terpenes: their structures, physiological roles, synthetic methods, and medicinal importance.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Reagents in Organic Synthesis	Oxidation with DDQ, CAN and SeO_2, mCPBA, Jones Oxidation, PCC, PDC, PFC, Collin's reagent and ruthenium tetraoxide. Reduction with $NaBH_4$, $LiAlH_4$, Meerwein-Ponndorf-Verley (MPV) reduction, Wilkinson's catalyst, Birch reduction, DIBAL-H	8	1
2	Organometallic Compounds	Organomagnesium compounds: the Grignard reagents, formation, structure, and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.	8	1
3	Chemistry of Aldehydes and ketones	Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Oxidation of aldehydes, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner,	8	2
4	Carboxylic acids and their Functional Derivative	Nomenclature and classification of aliphatic and aromatic carboxylic acids. Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation, Reactions: Mechanism of reduction, substitution in alkyl or aryl group. Preparation and properties of dicarboxylic acids such as oxalic, malonic, adipic and phthalic acids and unsaturated carboxylic acids such as acrylic and cinnamic acids, Reactions: Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, stereospecific addition to maleic and fumaric acids. Preparation and reactions of acid chlorides, acid anhydrides, amides and esters, acid and alkaline hydrolysis of esters, trans-esterification.	6	2
5	Organic Synthesis via Enolates	Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.	8	3
6	Organic Compounds of Nitrogen	Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction.	8	3
7	Heterocyclic Chemistry	Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles,	8	4
8	Natural Products	Alkaloids & Terpenes: Natural occurrence, General structural features, their physiological action, Hoffmann's exhaustive methylation, Emde's modification; Medicinal importance of Nicotine, Quinine, Morphine, Cocaine, and Reserpine. Natural Occurrence and classification of terpenes, isoprene rule.	6	5

Reference Books:

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.

Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.

Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.

Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.

e-Learning Source:
http://heecontent.upsdc.gov.in/Home.aspx https://nptel.ac.in/courses/104/103/104103111/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm https://nptel.ac.in/courses/104/103/104103071/#
https://swayam.gov.in/
http://heecontent.upsdc.gov.in/Home.aspx https://nptel.ac.in/courses/104/103/104103111/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm https://nptel.ac.in/courses/104/103/104103071/#

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

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

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

SDG-3,4

Effective from Session: 2024-2025							
Course Code	B020602T/CH354	**Title of the Course**	Chemical Energetics and Radio Chemistry	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Six	3	1	0	4
Pre-Requisite	Diploma	**Co-requisite**	-				
Course Objectives	The main aim of this course is to convey fundamental knowledge of the laws of thermodynamics and their applications, phase equilibria of one- and two-component systems, electrochemistry, ionic equilibrium applications of conductivity, and potentiometric measurements. Higher education studies have proven that to be quite important. The learner will be able to investigate topics in their appropriate dimensions after completing the course.						

Course Outcomes	
CO1	Students would perceive the sound knowledge of the first law of thermodynamics and various energies such as internal energy and enthalpy. Students would also gain insight into the knowledge of thermochemistry and various reaction enthalpies. Students gained insight into the laws of thermodynamics, the importance of entropy, and gibbs free energy. Nernst heat theorem, statement, and concept of residual entropy.
CO2	Students would evaluate the fundamentals of electrochemistry and enhance their knowledge of the basics of electrochemistry, conductometric titrations, and the Ostwald dilution law. Degree of ionization. Students also learn about electrodes, electrochemical cells, pH, buffer solutions, and salt hydrolysis.
CO3	Students would evaluate the fundamentals of the surface chemistry laws of adsorption and colloids. Students also learn about dilute solutions and colligative properties. It enables us to understand the reactants in catalysis.
CO4	Students would have a solid knowledge of the basics of photochemistry, the Jablonski diagram, and different photophysical processes.
CO5	Students would be able to learn about radioactivity. It enables us to understand the applications of radiochemistry in energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, and nuclear medicine.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	First Law of Thermodynamics	Statement, definition of internal energy and enthalpy. Heat capacity,heat capacities at constant volume and pressure and their relationship. Joule's law– Joule Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Thermochemistry: Standard state, standard enthalpy of formation – Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation	8	1
2	Thermodynamics-II	Second Law of Thermodynamics, Need for the law, different statements of the law, Carnot cycle andits efficiency. Carnot theorem. Thermodynamic scale of temperature. Concept of Entropy, Entropy as a state function, entropy as a function of V & T, entropy as a functionof P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Helmholtz Functions Gibbs function (G) and Helmhotz work 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. Third Law of Thermodynamics; Nernst heat theorem, statement and concept of residual entropy. Nernst distribution law – Thermodynamic derivation, applications	8	1
3	Electrochemistry	Electrical transport:- Conduction in metals and in electrolyte solutions, specificconductance molar and equivalent conductance, measurement of equivalent conductance, variationof molar, equivalent and specific conductances with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes . Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.	7	2
4	Ionic Equilibrium	Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, Electrolytic and Galvanic cells–Reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement. Definitionof pH and pKa , determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers – Mechanism of buffer action, Henderson-Hazel equation, application of buffer solution. Hydrolysis of salts.	8	2
5	Surface Chemistry	Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isothermand surface excess; Heterogenous catalysis (single reactant); Colloids:Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids,Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Stability of colloids and zeta potential; Micelle formation	7	3
6	Colligative Properties	Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.	8	3
7	Photo Chemistry	Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagramdepicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantumyield, photosensitized reactions – energy transfer processes (simple examples), kinetics of photochemical reaction.	6	4
8	Radiochemistry	Natural and induced radioactivity; radioactive decay-a-decay, b-decay, g-decay; neutromemission, positrom emission, electron capture; unit of radioactivity (Curie); half life period; Geiger-Nuttal rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters scintillation counters. Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, nuclear medicine-99mTc radiopharmaceuticals.	8	5

Reference Books:

Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press (2010).
Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill (2009).
Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
Castellan, G. W. Physical Chemistry 4th Edn. Narosa (2004).
e-Learning Source:
https://www.mooc-list.com/tags/physical-chemistry
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
https://www.coursera.org/learn/physical-chemistry

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

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

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

SDG: 4, 8

Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	B020603P/CH355	**Title of the Course**	Analytical Methods	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Six	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	The main objective of this course is to provide essential knowledge of laboratory techniques and tests for estimating metal ions and chromatographic separation of amino acids and sugars. The lab course also delivers knowledge and experimentation-based understanding of the ionization enthalpies of acids and bases.						

Course Outcomes	
CO1	Students would be able to learn about laboratory methods and tests related to the estimation of metal ions and gravimetric analysis.
CO2	Students would be able to understand and evaluate the chromatography separation and perform the paper chromatography experimentation.
CO3	Students would be able to remember, understand, and perform the thin layer chromatography experimentation.
CO4	Students would be able to understand the solubility behavior of compounds at different temperatures.
CO5	Students would be able to understand, analyze, and perform experiments related to the enthalpy of neutralizing acids and bases and lattice energy calculations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Gravimetric Analysis	Estimation of one anion and cation in a given salt: 1. Analysis of Cu as CuSCN, 2. Analysis of Ni as Ni(dimethylgloxime) 3. Analysis of Ba asBaSO4	15	1
2	Paper Chromatography	Ascending and Circular Rf of organic compounds, Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid Leucine and glutamic acid. Spray reagent ninhydrin. Separation of a mixture of D, L alanine, glycine, and L-leucine using n-butanol:acetic acid: water (4:1:5). Spray reagent ninhydrin. Separation of monosaccharaides a mixture of D- galactose and D –fructose using n- butanol: acetone: water (4:5:1). Spray reagent aniline hydrogen phthalate	15	2,3
3	Thin Layer Chromatography	Determination of Rf values and identification of organic compounds: Separation of green leaf pigments (spinach leaves may be used) Preparation of separation of 2,4- dinitro phenyl hydrazones of acetone, 2- butanone, hexan-2, and 3-one using toluene and light petroleum (40:60), Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5)	15	2,3
4	Thermochemistry	To determine the solubility of benzoic acid at different temperatures and to determine H of the dissolution process. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born-Haber cycle.	15	4,5

Reference Books:

Practical Chemistry: For B.Sc, S. Chand Limited, OP pandey, DN Bajpai, 2022.

Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.

B.Sc.-III Practical Chemistry, Dr. Pradip P. Deohate, ISBN : 978-93-5445-764-7

Instrumental Methods of Analysis, CBS Publishers & Distributors, Willard M.H., ISBN 9788123909431

e-Learning Source:

https://youtu.be/UHYfgwjE2i4

http://zd2.chem.uni.wroc.pl/files/chemistry/10A_ENG.pdf

https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/chemistry/lelm103.pdf

https://rltsc.edu.in/wp-content/uploads/2021/03/E-Book-B.Sc_.-III-Practical-Chemistry.pdf

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	-	-	-	-	1	-	2	1	-	-
CO2	2	3	-	-	-	-	2	-	3	2	-	-
CO3	2	2	-	-	-	-	2	-	2	1	-	-
CO4	3	3	-	-	-	-	1	-	3	2	-	-
CO5	3	1	-	-	-	-	1	-	3	3	-	-

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

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

Effective from Session: 2024-25							
Course Code	B020604R/CH356	**Title of the Course**	Chemistry Research Project-2	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Sixth	0	0	10	5
Pre-Requisite	Diploma	**Co-requisite**	-				
Course Objectives	To provide the industrial exposure and enhance technical skills of students						

Course Outcomes	
CO1	Hands on training
CO2	Integrate classroom theory with laboratory practice.
CO3	Understanding professional ethics of industry and code of conduct.
CO4	Essential training in laboratory safety procedures
CO5	Compilation of data and report writing

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

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

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