Revised Scheme B, C &D

Chaudhary Ranbir Singh University, Jind

Scheme of Examination for the Chemistry Subject in Under Graduate Programmes

As per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes

(Multiple Entry- Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2023-24 (in phased manner)

Semester	Course Type	Applicable Scheme	Course Code	Nomenclature of course	Credits			Contact hours L: Lecture P: Practical T:Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
					Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
1	MCC-1	Scheme C	B-23-CHE-104	**Inorganic Chemistry-I:** Atomic Structure, Chemical Bonding& Acid- Base Concept	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-2	Scheme C	B-23-CHE-105	**Organic Chemistry I:** Basic Concepts, Hydrocarbons, Haloalkanes and Haloarenes	4	3	1	3	2	5	20	10	50	20	100	3	3
	CC-M1	Scheme C	B-23-CHE-104	**Inorganic Chemistry-I:** Atomic Structure, Chemical Bonding & Acid- Base Concept	4	3	1	3	2	5	20	10	50	20	100	3	3
	MDC-1	Scheme C& D	B-23-CHE-106	**Introductory Chemistry-I:** Bonding, Carbon Compounds and Food Preservatives	3	2	1	2	2	4	15	5	35	20	75	3	3
2	MCC-3	Scheme C	B-23-CHE-204	**Physical Chemistry-I:** States Of Matter , Chemical Kinetics &Ionic Equilibrium	4	3	1	3	2	5	20	10	50	20	100	3	3

	DSEC-1	SchemeC	B-23-CHE-205	**Chemistry Skill-I:** Chemistry Lab-Maintenance And Handling	4	3	1	3	2	5	20	10	50	20	100	3	3
	CC-M2	Scheme C	B-23-CHE-105	**Organic Chemistry-I:** Basic Concepts, Hydrocarbons, Haloalkanes and Haloarenes	4	3	1	3	2	5	20	10	50	20	100	3	3
	MDC-2	Scheme C& D	B-23-CHE-206	**Introductory Chemistry-II:** Indian Scientists, Matter, Soil & Fertilizers	3	2	1	2	2	4	15	5	35	20	75	3	3
	Internship of 4 credits of 4-6 weeks duration after 2nd Semester																
	2nd YEAR																
3	MCC-4	Scheme B & C	B-23-CHE-304	**Inorganic Chemistry-II:** Chemistry of s- and p-block elements	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-5	Scheme B & C	B-23-CHE-305	**Organic Chemistry II:** Oxygen and Nitrogen containing functional groups	4	3	1	3	2	5	20	10	50	20	100	3	3
	CC-M3	Scheme B, C & D	B-23-CHE-204	**Physical Chemistry-I:**States of Matter , Chemical Kinetics & Ionic Equilibrium	4	3	1	3	2	5	20	10	50	20	100	3	3
	MDC-3	Scheme B, C & D	B-23-CHE-306	**Introductory Chemistry-III:** Chemistry and Social Life	3	2	1	2	2	4	15	5	35	20	75	3	3

4	MCC-6	Scheme B & C	B-23-CHE-402	**Physical Chemistry-II:** Thermodynamics and Colligative Properties	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-7	Scheme B & C	B-23-CHE-403	**General Chemistry-I:** General Spectroscopy	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-8	Scheme B & C	B-23-CHE-404	**General Chemistry-II:** Nuclear and Polymer Chemistry	4	3	1	3	2	5	20	10	50	20	100	3	3
	DSE-1	Scheme B & C	B-23-CHE-405 (E1)	**Elective Chemistry-I (Inorganic Chemistry):** Environmental Chemistry	4	3	1	3	2	5	20	10	50	20	100	3	3
			B-23-CHE-405 (E2)	**Elective Chemistry-II (Organic Chemistry):** Organic Biomolecules	4	3	1	3	2	5	20	10	50	20	100	3	3
			B-23-CHE-405 (E3)	**Elective Chemistry-III (Physical Chemistry):** Phase Equilibria and Surface Chemistry	4	3	1	3	2	5	20	10	50	20	100	3	3
	CC-M4(V)	Scheme B & C	**From The Available pool of Vocational courses of 4 credits of University as per NEP**		4	3	1	3	2	5	20	10	50	20	100	3	3
	Internship of 4 credits of 4-6 weeks duration after Fourth semester (if not done after second semester)																

3rd YEAR

5	MCC-9	Scheme B & C	B-23-CHE-502	**Inorganic Chemistry III:**	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-10	Scheme B & C	B-23-CHE-503	**Organic Chemistry III:**	4	3	1	3	2	5	20	10	50	20	100	3	3
	DSE-2	Scheme B & C	B-23-CHE-504(E4)	**Elective Chemistry-IV (Inorganic Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
			B-23-CHE-504 (E5)	**Elective Chemistry-V (Organic Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
	DSE-3	Scheme B & C	B-23-CHE-505 (E6)	**Elective Chemistry-VI (Physical Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
			B-23-CHE-505 (E7)	**Elective Chemistry-VII (Analytical methods in Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
	CC-M5 (V)	Scheme B & C	**From The Available pool of Vocational courses of 4 credits of University as per NEP**		4	3	1	3	2	5	20	10	50	20	100	3	3
6	MCC-11	Scheme B & C	B-23-CHE-602	**Physical Chemistry-III:**	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-12	Scheme B & C	B-23-CHE-603	**General Chemistry-III**	4	3	1	3	2	5	20	10	50	20	100	3	3

DSC-4	Scheme B & C	B-23-CHE-604 (E8)	**Elective Chemistry-VIII (Physical Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
	Scheme B & C	B -23-CHE-604 (E9)	**Elective Chemistry-IX (Organic Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
DSE-5	Scheme B & C	B-23-CHE-605 (E10)	**Elective Chemistry-X (Inorganic Chemistry):**	4	3	1	3	2	5	20	10	50	20	100	3	3
	Scheme B & C	B-23-CHE-605 (E11)	**Elective Chemistry-XI (Organic Chemistry):** Medicine & Drug													
CC-M6 (V)	Scheme B & C	**From The Available pool of Vocational courses of 4 credits of University as per NEP**		4	3	1	3	2	5	20	10	50	20	100	3	3

ote: 1) Four Credits of Internship Earned By a Student during Summer Internship after 2nd Semester or 4th Semester Will Be Taken Into Account In Fifth Semester of a Student Who ursue 3 Year UG Programme Without Taking Exit Option

2) Scheme of 7th and 8th semester will be decide later on.

Course composition-Theory/Theory + Tutorial			
Course Credit	Internal Assessment marks	End term exam marks	Total marks
2	15	35	50
3	25	50	75
4	30	70	100

Course composition-Theory + Practical					
Course Credit	Theory		Practical		Total marks
Theory + Practical	Internal Assessment marks	End term exam marks	Internal Assessment marks	End term exam marks	
1+1	10	20	5	15	50
2+1	15	35	5	20	75
2+2	15	35	15	35	100
3+1	20	50	10	20	100
0+4	NA	NA	30	70	100

1. Internal assessment(30%) shall be broadly based on the following defined components of;
   a. Class participation
   b. Seminar/Presentation/Assignment/Quiz/class test, etc.
   c. Mid Term Exam

Total Internal Assessment Marks (Theory)	Class Participation	Seminar/Presentation/Assignment/Quiz/class test, etc.	Mid-Term Exam
10	4	-	6
15	4	4	7
20	5	5	10
25	5	7	13
30	5	10	15

Total Internal Assessment Marks (Practicum)	Class Participation	Seminar/Demonstration/Viva-Voce/Lab record, etc.	Mid-Term Exam
5		5	NA
10		10	NA
15	5	10	NA
30	5	10	15

Course Type: MCC-1

Session: 2023-24	
Part A – Introduction	
Subject	Chemistry
Semester	I
Name of Course	**INORGANIC CHEMISTRY – I** Atomic Structure, Chemical Bonding & Acid- Base Concept
Course Code	B-23-CHE-104
Course Type: (MCC/CC/MDC/DSEC/VOC/DSE/PC/AEC/ VAC)	MCC
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	4.0
Course Learning Outcomes(CLO):	1. Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements. 2. Draw the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR theory and MO diagrams (homo-& hetero-nuclear diatomic molecules). 3. Understand the concept of lattice energy using Born-Landé equation. 4. Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory. --- 1. *Calibrate apparatus used in titrimetric analysis. 2. *Prepare standard solutions for titration. 3. *Comprehend the theory of acid-base and redox titrations 4. *Understand the theory and application of acid-base

	5. *Understand the theory behind estimation of metal ions and hydrated water		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*		**Time:03 + 03***	

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**12 Hours** **Atomic Structure** Dual behavior of matter and radiation, de Broglie's relation, Heisenberg's uncertainty principle, concept of atomic orbital's, significance of quantum numbers, radial and angular wave functions, normal and orthogonal wave functions, significance of Ψ and Ψ^2, shapes of s, p, d, f orbital's, Rules for filling electrons in various orbital's, effective nuclear charge, Slater's rules. **Periodic table and atomic properties** Classification of periodic table, definition of atomic and ionic radii, ionisation energy, electron affinity and electronegative it, trend in periodic table (in s and p-block elements), Pauling, Mulliken, Allred Rachow and Mulliken Jaffe's electronegativity scale, Sanderson's electron density ratio.
II	**11 Hours** **Covalent Bond** Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear

	(N_2, O_2) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond. **Ionic Solids** Ionic structures (NaCl, CsCl, ZnS (Zinc blende), CaF_2) size effects, radius ratio rule and its limitations, Concept of Lattice energy, Born- Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule.
III	**Molecular Orbital Theory:** **11 Hours** Molecular orbital diagrams of homo & hetero diatomic and simple polyatomic molecules [N_2, O_2, C_2, B_2, F_2, CO, NO] and their ions; HCl (idea of s-p mixing and orbital interaction to be given). **Acids and Bases:** Bronsted-Lowry concept of acid-base, relative strength of acids, elementary idea of levelling solvents, Lewis acid-base concept, Hard and Soft Acids and Bases (HSAB), Application of HSAB principle.
IV	**Hydrogen Bonding and Van-der Waals forces** **11 Hours** Hydrogen Bonding – Definition, types, effects of hydrogen bonding on properties of substances, application Brief discussion of various types of Van-der Waals forces. **Metallic Bond and semiconductors** Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors – Introduction, types, and applications.
V*	**1. Titrimetric Analysis:** **30 hours** (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality. **2. Estimation of acid and alkali contents: (any two).** (i) Determination of acetic acid in commercial vinegar using NaOH. (ii) Determination of alkali content-antacid tablet using HCl. (iii) Estimation of oxalic acid by titrating with $KMnO_4$. **3. Estimation of inorganic salts and hydrated water. (any two)** (i) Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. (ii) Estimation of calcium content in chalk by permanganometry. (iii)Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

Suggested Evaluation Methods	
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education.
3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), Concepts and Models of Inorganic Chemistry, John Wiley & Sons.
4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010),
5. Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
6. Pfennig, B. W. (2015), Principles of Inorganic Chemistry. John Wiley & Sons.
7. Housecraft, C. E.; Sharpe, A. G., (2018), Inorganic Chemistry, 5th Edition, Pearson.
8. Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited.
9. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.
10. Shiver, D.; Weller, M.; Overton, T.; Rourke, J.; Armstrong, F. (2014), Inorganic Chemistry, 6th Edition, Freeman & Company
11. Das, A. K.; Das, M. (2014), Fundamental Concepts of Inorganic Chemistry, 1st Edition,
12. Volume CBS Publishers & Distributors Pvt. Ltd.
13. 1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
14. Harris, D. C.; Lucy,C. A.(2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company.
15. Mendham J., Vogel's Quantitative Chemical Analysis, Pearson, 2009.

**Applicable for courses having practical component.*

Course Type: MCC 2:

Session: 2023-24	
Part A – Introduction	
Subject	Chemistry
Semester	I
Name of Course	**ORGANIC CHEMISTRY – I** Basic Concepts, Hydrocarbons, Haloalkanes and Haloarenes
Course Code	B-23-CHE-105
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MCC
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	4.0
Course Learning Outcomes (CLO):	1. Understand and explain the electronic displacements and reactive intermediates and their applications in basic concepts. 2. Formulate the mechanistic route of organic reactions by recalling and correlating the fundamental concepts. 3. Identify and comprehend mechanism for Free Radical Substitution, Electrophilic Addition, Nucleophilic Substitution and Elimination reactions. 4. Understand the fundamental Concepts of stereochemistry. 1. *Understand the intricacies of organic synthesis and purification techniques. 2. *Use crystallization for separation and purification of organic compounds

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*		Time:03 + 03*	

Part B-Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**Structure and Bonding** **11 Hours** Localized and delocalized chemical bond, Van der Waals interactions. Concept of resonance and its applications, hyperconjugation, inductive effect, Electromeric effect and their comparison. **Mechanism of Organic Reactions** Curved arrow notation, homolytic and heterolytic bond fission. Types of reagents: electrophiles and nucleophiles. Types of organic reactions: Substitution, Addition, Condensation, Elimination, Rearrangement, Isomerization and Pericyclic reactions. Reactive intermediates: Carbocations, carbanions, free radicals, carbenes (structure & Stability).
II	**Stereochemistry** **11 hours** Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. Specific rotation; Configuration and projection formulae: Newmann, Sawhorse, Fischer and their inter conversion. Racemic mixture and their resolution. Relative and absolute configuration: D/L and R/S designations (CIP rules).Geometrical isomerism: cis-trans, syn-anti and E/Z notations. Conformational Isomerism: Alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane). Relative stability of cycloalkanes (Baeyer strain theory), Cyclohexane conformations with energy diagram.

III	**Alkanes and Cycloalkanes** **12 Hours** Nomenclature, classification of carbon atoms in alkanes and its structure. Isomerism in alkanes, sources. Methods of formation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity. Nomenclature of Cycloalkanes, Baeyer's strain theory and its limitations, theory of strainless r ings. **Alkenes** Nomenclature of alkenes and its structure. Methods of formation: dehydration of alcohols, dehydrohalogenation of alkyl halide, Hofmann elimination and their mechanism. The Saytzeff rule and relative stabilities of alkenes. Chemical reactions: electrophilic and free radical additions, addition of halogens, halogen acids, hydroboration–oxidation, oxymercuration-reduction, ozonolysis and hydration. Markownikoff's rule of addition.
IV	**Haloalkanes** **11 hours** Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitutionV/s elimination. **Haloarenes** Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; S_NAr, Benzyne mechanism. Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.
V*	1. Calibration of a thermometer and determination of the melting points of the organic compounds. **30 hours** 2. Determination of boiling point of liquid compounds. 3. Concept of Recrystallisation using alcohol/water/alcohol-water as solvent. 4. Organic Preparation: A. Bromination of acetanilide/aniline/phenol B. Nitration of nitrobenzene/Chlorobenzene i. C. Acetylation of aniline and phenols.
Suggested Evaluation Methods		

Internal Assessment:20+10*	End Term Examination:
➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Morrison, R.N., Boyd, R.N., Bhattacharjee, S.K.(2010), **Organic Chemistry**, 7th Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I.L. (2002), **Organic Chemistry** (Volume1), 6th Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. B. Mehta & M. Mehta, Organic Chemistry, PHI Learning, 2005.
4. Eliel, E.L., Wilen, S.H. (1994), **Stereochemistry of Organic Compounds**; Wiley: London.
5. P.S Khalsi, Sterechemistry of Organic Compouns, New Age International PVT. LTD., 2nd edition, (2016).
6. Nasipuri, D.(2018), **Stereo chemistry of Organic Compounds: Principles and Applications**, 4th Edition, New Age International.
7. Mann, F.G., Saunders, B.C.(2009), **Practical Organic Chemistry**,4th Edition, Pearson Education.
8. Ahluwalia, V.K., Dhingra, S. (2004), **Comprehensive Practical Organic Chemistry: Qualitative Analysis**, University Press.
9. Furniss, B.S., Hannaford, A.J., Smith, P.W.G.; Tatchell, A.R (2004), **Vogel's Text book of Practical Organic Chemistry**, Pearson.
10. Leonard, J., Lygo, B., Procter, G. (2013) **Advanced Practical Organic Chemistry**, 3rd Edition, CRC Press.

Additional Resources:

1. Solomons, T.W.G., Fryhle, C.B., Snyder, S.A.(2017), **Organic Chemistry**, 12th Edition, Wiley.
2. Bruice, P.Y.(2020),**Organic Chemistry**, 8th Edition, Pearson.
3. Clayden, J., Greeves, N., Warren, S . (2014), **Organic Chemistry**, Oxford.

**Applicable for courses having practical component.*

Course Type : MDC-1

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	I		
Name of Course	**INTRODUCTORY CHEMISTRY – I** Bonding, Carbon compounds and Food Preservatives		
Course Code	B-23-CHE-106		
Course Type: (MCC/CC/MDC /DSEC/VOC/DS E/PC/AEC/ VAC)	MDC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	Higher Secondary other than Science Discipline		
Course Learning Outcomes (CLO):	1. To get knowledge about structure and bonding. 2. To learn about hydrocarbons and their applications. 3. To get aware about different polymers. 4. To get knowledge about preservative. 1. *To get knowledge about experiments related to daily life		
Credits	**Theory**	**Practical**	**Total**
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+25* Internal Assessment Marks:15+05* End Term Exam Marks:35+20*		**Time:03 + 03* Hrs**	

Part B- Contents of the Course	
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.	
Unit	**Topics**
I	**Atomic Structure and Bonding** **8 hours** Introduction, Elementary introduction of atomic structure and chemical bonding, Representation of elements/ atoms, Lewis structure, electronic configurations
II	**Carbon and Its Compounds** **8 hours** Introduction, Tetravalency of Carbon, allotropes of carbon and their properties, hydrocarbons (1-5), nomenclature (linear compounds), Applications of hydrocarbons.
III	**Polymers** **7 hours** Introduction, elementary idea of synthetic and natural polymers, Homo polymers and copolymers, uses and properties (Natural rubber, Vulcanized rubber, Polyethene, PVC, Styrene, Teflon, PAN, Nylon-66)
IV	**Preservatives** **7 hours** Elementary idea of natural and synthetic food preservatives, rancidity, uses and properties, different food preservation processes (pickle, Jam), artificial sweeteners, uses and properties
V*	**30 hours** 1. Identify the pH of the given samples through pH strip. 2. Experiments related to persevering food items. 3. Preparation of Artificial Silk. 4. To synthesize some polymers as per available resources.

Suggested Evaluation Methods	
Internal Assessment:15+05* ➢ **Theory** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 07 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 05 • Mid-Term Exam: NA	**End Term Examination:** 35+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Dhawan S.N., Organic Chemistry, Vol 1 Pardeep Publication.
2. Subbu lakshmi G, Food processing and preservation, New Age International Publishers.
3. Manas Chanda, 2013, Introduction to Polymer Science and Chemistry 2nd Edition, Making Rayon Fiber - Artificial silk, chemical experiment! How to make silk from cotton wool ("Artificial silk" experiment)
4. Neelam Seedher, Basic Concepts: Physical Chemistry Experiments, Kindley Edition

**Applicable for courses having practical component.*

Course Type: MCC-3

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	II		
Name of Course	**PHYSICAL CHEMISTRY – I** States of Matter, Chemical Kinetics & Ionic Equilibrium		
Course Code	B-23-CHE-204		
Course Type: (MCC/CC/MDC /DSEC/VOC/DS E/PC/AEC/ VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	1. Derive mathematical expressions for different properties of gas, liquid and solid and understand their physical significance. 2. Explain the crystal structure and calculate related properties of cubic systems. 3. Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt. 1. * Handon Practice for estimation & determination of Viscosity and Surface tension		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**11 Hours** **Gaseous State** Kinetic theory of gases, Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity, and most Probable velocity. Collision diameter, collision number, collision frequency and mean free path (Derivations excluded), Deviation of Real gases from ideal behaviour, Derivation of Van der Waal' s Equation of State, its application in the calculation of Boyle' s temperature (compression factor) **Critical Phenomenon** Concept of Critical temperature, critical pressure, critical volume, relationship Between critical constants and Van der Waal's constants (Derivation excluded)
II	**11 Hours** **Liquid State** Structure of liquids, Properties of liquids – surface tension, refractive index, viscosity, vapours pressure and optical rotation. **Solid State** Classification of solids, Law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry and symmetry elements, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of Laue method, rotating crystal method and powder pattern method.
III	**11 Hours** **Chemical Kinetics** Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, Half-life period of a reaction, Arrhenius equation. **Distribution Law** Nernst distribution law – its thermodynamic derivation, Nernst distribution law after

	association and dissociation of solute in one of the phases, of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride
IV	**Ionic equilibrium** **12 hours** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves. Theory of acid–base indicators.
V*	**30 hours** **A. Surface tension measurements using stalagmometer.** (i) Determine the surface tension by (i) drop number (ii) drop weight method. (ii) Study the variation of surface tension with different concentration of detergent solutions. Determine CMC. **B. Viscosity measurement using Ostwald's viscometer.** (i) Determination of co-efficient of viscosity of a unknown aqueous solution. Study the variation of viscosity with different concentration of sugar solutions.

Suggested Evaluation Methods

Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Atkins, P.W.; Paula, J.de.(2014), **Atkin's Physical Chemistry Ed.**,10th Edition, Oxford University Press.
2. Ball, D.W. (2017), **Physical Chemistry,** 2nd Edition, Cengage Learning, India.
3. Castellan, G.W. (2004), **Physical Chemistry**, 4th Edition, Narosa.
4. Kapoor, K.L. (2015), **A Text book of Physical Chemistry**, Vol 1, 6th Edition, McGraw Hill Education.
5. B. D. khosala, V. C. Garg, A. Gulati, Senior Practical Physical Chemistry, R. Chand (2015).
6. V. K. Ahluwalia, S. Dhingra, A. Gulati, College Practical Chemistry, University Press.

Additional Resources:

1. Moore, W.J. (1972), Physical Chemistry, 5th Edition, Longmans Green & Co. Ltd.
2. Glasstone, S. (1948), Text book of Physical Chemistry, D. Van No strand company, New York.

**Applicable for courses having practical component.*

Course Type: DSEC-1

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	I		
Name of Course	**Chemistry Skill-I** Chemistry Lab-Maintenance and Handling		
Course Code	B-23-CHE-205		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	DSEC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	1. Aware about lab handling and handling of hazardous chemicals. 2. Determine percentage purity and knowledge to prepare buffer solutions. 3. To know preparation of complexometric titration and purification techniques. 4. To get operating knowledge of different instruments. 1. *To get practical knowledge about complexometric titrations and paper chromatography. Also determination some physical properties of some compounds/ solutions		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**Laboratory practices-I** **11 hours** Familiarization with chemical labeling, Handling of hazardous chemicals, Handling of glassware. Sodium metal disposal, Familiarization with chemical concepts related to solution preparation and standardization: Equivalent mass, molar mass, specific gravity, concentration (Normality, Molarity, Molality, %w/v, %w/w, %v/v, ppm, ppb solutions), Basicity, acidity, solutions of oxidizing and reducing agents.
II	**Laboratory practices-II** **11 hours** Determination of concentration and percentage purity. Standardization of solutions, Knowledge about primary and secondary standards. Knowledge about indicators and preparation of indicator solutions, Knowledge about buffers and preparation of buffer solutions.
III	**Laboratory practices-III** **11 hours** Preparation of complexometric solutions (e.g. EDTA solutions) and titrations, Management of chemical waste. Purification of chemicals through distillation, crystallization, sublimation etc. Operating knowledge including calibration, handling and maintenance of Potentiometers and conductometer.
IV	**Instrument Handling** **12 hours** Knowledge about different electrodes (e.g. Ag, Pt, SCE, Ag/AgCl) and their upkeep, Operating knowledge including calibration and maintenance of pH-meters and glass electrode, Operating knowledge including calibration and maintenance of refractometer, polarimeter, Flame-photometer, Spectrophotometer, Interferometer and

	Dipole meter.
V*	**30 hours** 1. **Complexometric titrations:** Determination of Zn^{2+} by EDTA. 2. **Paper Chromatography:** Qualitative Analysis of any two of the following Inorganic cations and anions by paper chromatography (Pb^{2+}, Cu^{2+}, Ca^{2+}, Ni^{2+}, Cl^-, Br^-, I^- and PO_4^{3-} and NO_3^-). 3. To determine the viscosity of given liquid using Ostwald's Viscometer. 4. To determine the specific refractivity of at least three liquids by Refractometer. 5. Preparation of Dibenzalacetone from Acetone and Benzaldehyde 6. Preparation of 2,4-DNP derivative of Benzophenone. 7. Separation of mixture of two Organic Compounds by TLC.

Suggested Evaluation Methods	
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & amp; Co, New Delhi.
2. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.

**Applicable for courses having practical component.*

Course Type: MDC-2

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	II		
Name of Course	**INTRODUCTORY CHEMISTRY – II** Indian Scientists, Matter, Soil & Fertilizers		
Course Code	B-23-CHE-206		
Course Type: (MCC/CC/MDC /DSEC/VOC/DS E/PC/AEC/ VAC)	MDC		
Level of Course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	Higher Secondary other than science disciplines		
Course Learning Outcomes (CLO):	1. To learn about role of Indian scientists in the upliftment of research 2. To learn about classification of elements with their properties 3. To learn about three states of matter 4. To get more knowledge about role of fertilizers in fertility of soil 5. To learn about acid- base reaction in daily life		
Credits	**Theory**	**Practical**	**Total**
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+25* Internal Assessment Marks:15+5* End Term Exam Marks:35+20*		**Time:03 + 03***	

Part B- Contents of the Course	
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.	
Unit	**Topics**
I	**Renowned Indian Scientists** **8 hours** Brief Biography of Renowned Indian Scientists (Hargobind Khurana, Dr. P.C. Ray, Sir C.V. Raman, Dr. A.P.J. Abdul Kalam, C. N. R. Rao, Dr. Vikram Sara Bhai, Dr. Homi Jahangir Bhabha, Dr. J.C. Bose, Dr. S. N. Bose)
II	**Metal and Non-Metals** **8 hours** Periodic table, classification of elements, physical and chemical aspects of metals and non-metals, Ore and Minerals of Iron, Copper, Aluminium, alloys
III	**Physical Properties of Matter** **7 hours** Classification of matter, properties, uses, ideal gas equation, real gas equation, some important compounds (baking soda, washing soda, plaster of Paris, gypsum, glass)
IV	**Soil and fertilizers** **7 hours** Green revolution, soil: types of soil and their components for fertility grow condition, pH, irrigation, biofertilizers, chemical fertilizers and their uses, acid rain.
V*	**30 hours** 1. To prepare Plaster of Paris 2. To prepare Potash Alum 3. To study the effect of acid on Baking and washing soda 4. To perform the action of water on quick lime and identify the nature of reaction (Exo/Endothermic)
Suggested Evaluation Methods	

Internal Assessment:15+5*	End Term Examination:
➢ **Theory** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 05 • Mid-Term Exam: NA	35+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Chemistry In Daily Life : Third Edition by Kirpal Singh , PHI Learning
2. General Chemistry: Principles, Patterns, and Applications, Bruce Averill, Strategic Energy Security Solution, Patricia Eldredge, R.H. Hand, LLC, Copyright Year: 2011
3. The Great Indian Scientists Paperback – 1 January 2017, Cengage Learning India

**Applicable for courses having practical component.*

Course type-MCC-4

Session: 2024-25	
Part A – Introduction	
Subject	Chemistry
Semester	III
Name of Course	**INORGANIC CHEMISTRY – II** : Chemistry of s- and p-block Elements
Course Code	B-23-CHE-304
Course Type: (MCC/CC/MDC/DSEC/VOC/DSE/PC/AEC/ VAC)	MCC
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	4.0
Course Learning Outcomes (CLO):	• Learn the fundamental principles of metallurgy and understand the importance of recovery of by-products during extraction. • Applications of thermodynamic concepts like that of Gibbs energy and entropy to the principles of extraction of metals. • Comprehend the theory of Redox, iodometric and iodimetric titrimetric analysis. • Students will learn standard solution preparation for various inorganic titrations.

Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**Metallurgy & general properties of s-block elements** **11 hours** Occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, Van Arkel-De Boer process, Zone refining. General characteristics: melting point, flame colouration, reducing nature, diagonal relationships and anomalous behavior of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water.
II	**Compounds of s- block elements:** **11 hours** Formation, thermal stability, energetics of dissolution, and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates. Complex formation tendency of s-block elements; structure of the following complexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and magnesium. Solutions of alkali metals in liquid ammonia and their properties.
III	**Chemistry of p-block elements** **11 hours** Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Catenation, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group.
IV	**Compounds of p-Block Elements** **12 hours** Acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat on the following: Hydrides of Group 13 (only diborane), Group 14, Group 15 (EH_3 where E = N, P,As, Sb, Bi), Group 16 and Group 17, Oxoacids of phosphorus, sulphur and chlorine , Interhalogen and pseudohalogen compound, Clathrate compounds

	of noble gases, xenon fluorides (MO treatment of XeF_2).
V	**1. Redox Titrations** **30 hours** (i) Estimation of Fe(II) with $K_2Cr_2O_7$ using diphenylamine as internal indicator. (ii) Estimation of Fe(II) with $K_2Cr_2O_7$ using *N*-phenyl anthranilic acid as internal indicator. (iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using external indicator. **2. Iodo/Iodimetric Titrations** (i) Estimation of Cu(II) using sodium thiosulphate solution (Iodometrically). (ii) Estimation of $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodometrically). (iii) Estimation of antimony in tartaremetic iodimetrically.

Suggested Evaluation Methods	
Internal Assessment: 20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*
Part C-Learning Resources	

➢ **Practicum**	50+20*

Recommended Books/e-resources/LMS:

1. Lee, J. D.; (2010), Concise Inorganic Chemistry, Wiley India.
2. Huheey, J. E.; Keiter, E. A.; Keiter; R.L.; Medhi, O.K. (2009), Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education.
3. Atkins, P. W.; Overton, T. L.; Rourke, J. P.; Weller, M. T.; Armstrong, F. A. (2010), Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
4. Miessler, G. L.; Fischer P. J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.
5. Housecraft, C. E.; Sharpe, A. G., (2018), Inorganic Chemistry, 5thEdition, Pearson.
6. Greenwood, N. N.; Earnsaw, A., (1997), Chemistry of Elements, 2nd Edition, Elsevier.
7. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denney, R. C. (1989), Vogel's Text book of Quantitative Chemical Analysis, John Wiley and Sons.
8. Harris, D. C.; Lucy, C. A. (2016), Quantitative Chemical Analysis, 9th Edition, Freeman and Company.
9. Day, R. A.; Underwood, A. L. (2012), Quantitative Analysis, 6th Edition, PHI Learning Private Limited.

**Applicable for courses having practical component.*

Course type-MCC-5

Session: 2024-25	
Part A – Introduction	
Subject	Chemistry
Semester	III
Name of Course	**ORGANIC CHEMISTRY – II** Oxygen and Nitrogen containing functional groups
Course Code	B-23-CHE-305
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MCC
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	4.0
Course Learning Outcomes (CLO):	• Understand reactions of oxygen and nitrogen containing functional groups. • Use the synthetic chemistry learnt in this course to do functional group transformations. • Build a strong understanding of means, tools and techniques of organic synthesis. • Carry out systematic analysis of the unknown organic compound. • Use the reaction chemistry learnt thus far to establish the identity of the unknown organic compound.

Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B-Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator are allowed.

Unit	Topics
I	**Chemistry of Carbonyls Compounds** **11 hours** Preparation of Carbonyl compounds. Reaction of carbonyl compounds with ammonia derivatives, Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, and haloform reaction. Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC), addition reactions of α,β-unsaturated carbonyl compounds: Michael addition.
II	**Carboxylic acid & their derivatives** **11 hours** General method of preparation of acid and its derivates. Effect of substituents on acidic strength on carboxylic acids, HVZ reaction, typical reactions of dicarboxylic acids and hydroxy acids. Comparative study of nucleophilic acyl substitution for acid chlorides, anhydrides, esters and amides, Mechanism of acidic and alkaline hydrolysis of esters, Dieckmann and Reformatsky reactions, Hoffmannbromamide degradation and Curtius rearrangement. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.
III	**Nitro Compounds, &Amine** **11 hours** **Nitro compounds:** General methods of preparation: from alkyl halides, alkanes, oxidation of amines and oximes. Henry reaction, Nef reaction, Reduction-electrolytic reduction, reaction with nitrous acid, reduction in acidic, basic and neutral medium (for aromatic compounds) **Amines**: Preparation, chirality in amines (pyramidal inversion), Basicity of amines: Effect of substituents, solvent and steric effects, distinction between Primary, secondary and tertiary amines using Hinsberg's method and nitrous acid, Gabriel Phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination.

IV	**Diazonium salts, Nitriles and Isonitriles** **12 hours** **Diazonium Salts**: Synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds; Coupling reactions of diazonium salts (preparation of azo dyes). **Nitriles**: Preparation using following reactions: Dehydration of amides and aldoximes, substitution reaction in alkyl halides and tosylates, from Grignard reagents and from dehydrogenation of primary amines. Discuss with reaction mechanism: Reaction with Grignard reagent, hydrolysis, addition reaction with HX, NH_3, reaction with aqueous ROH, Reduction reactions-catalytic reduction and Stephen's reaction. Condensation reactions-Thorpe Nitrile Condensation. **Isonitriles**: Preparation from the following reactions: Carbylamine reaction, substitution in alkyl halides and dehydrogenation of *N*-substituted formamides.	
V	**Qualitative Analysis*:** **30 hours** Identification of organic compound characterization by chemical methods: (i) Preliminary Test, (ii) Functional Group Test (iii) Derivative Preparation.	
Suggested Evaluation Methods		
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		**End Term Examination:** 50+20*
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Wade, L.G., (2016), **Organic Chemistry**, 8th Edition, Pearson Education.
2. Morrison, R. N., Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
3. Finar, I.L. **Organic Chemistry** Volume 1, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
4. Finar, I.L. **Organic Chemistry** Volume 2, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
5. Solomons, T.W.G., Fryhle, C.B.; Snyder, S.A. (2017), **Organic Chemistry**, 12th Edition, Wiley.
6. Vogel, A.I. (2012), **Quantitative Organic Analysis**, Part 3, Pearson Education.
7. Mann, F.G., Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.
8. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, 5th Edition, Pearson.
9. Ahluwalia, V.K., Dhingra, S. (2004), **Comprehensive Practical Organic Chemistry**: Qualitative Analysis, University Press.
10. Ahluwalia, V.K., Aggarwal, R. (2004), **Comprehensive Practical Organic Chemistry**: Preparation and Quantitative Analysis, University Press.

**Applicable for courses having practical component.*

Course type-CC-M3

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of Course	**PHYSICAL CHEMISTRY – I** States of Matter, Chemical Kinetics & Ionic Equilibrium		
Course Code	B-23-CHE-204		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Learn the mathematical expressions for different properties of gas,liquid and solid and understand their physical significance. • Explain the crystal structure and caiculate related properties of cubic, systems. • Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt. • Student will learn Handon Practice for estimation determination of Viscosity and Surface tension of a given liquid.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**Gaseous State** **11 Hours** Kinetic theory of gases, Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity, and most Probable velocity. Collision diameter, collision number, collision frequency and meanfree path (Derivations excluded). Deviation of Real gases from ideal behaviour, Derivation of Van der Waal' s Equation of State, its application in the calculation of Boyle' s temperature (compression factor) **Critical Phenomenon** Concept of Critical temperature, critical pressure, critical volume, relationship Between critical constants and Van der Waal's constants (Derivation excluded)
II	**Liquid State** **11 Hours** Structure of liquids, Properties of liquids – surface tension, refractive index, viscosity, vapours pressure and optical rotation. **Solid State** Classification of solids, Law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry and symmetry elements, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple accountof Laue method, rotating crystal method and powder pattern method.
III	**Chemical Kinetics** **11 Hours** Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, Half-life period of a reaction, Arrhenius equation. **Distribution Law** Nernst distribution law – its thermodynamic derivation, Nernst distribution law after

	association and dissociation of solute in one of the phases, of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride
IV	**Ionic equilibrium** **12 hours** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves. Theory of acid–base indicators.
V*	**30 hours** **A. Surface tension measurements using stalagmometer.** (i) Determine the surface tension by (i) drop number (ii) drop weight method. (ii) Study the variation of surface tension with different concentration of detergent solutions. Determine CMC. **B. Viscosity measurement using Ostwald's viscometer.** (i) Determination of co-efficient of viscosity of a unknown aqueous solution. Study the variation of viscosity with different concentration of sugar solutions.

Suggested Evaluation Methods	
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Atkins, P.W.; Paula, J.de.(2014), **Atkin's Physical Chemistry Ed.**,10th Edition, Oxford University Press. 2. Ball, D.W. (2017), **Physical Chemistry**, 2nd Edition, Cengage Learning, India. 3. Castellan, G.W. (2004), **Physical Chemistry**, 4th Edition, Narosa. 4. Kapoor, K.L. (2015), **A Text book of Physical Chemistry**, Vol 1, 6th Edition, McGraw Hill Education. 5. B. D. khosala, V. C. Garg, A. Gulati, Senior Practical Physical Chemistry, R. Chand (2015). 6. V. K. Ahluwalia, S. Dhingra, A. Gulati, College Practical Chemistry, University Press. **Additional Resources:** 1. Moore, W.J. (1972), Physical Chemistry, 5th Edition, Longmans Green & Co. Ltd. 2. Glasstone, S. (1948), Text book of Physical Chemistry, D. Van No strand company, New York.

**Applicable for courses having practical component.*

Course type-MDC-3

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of Course	**INTRODUCTORY CHEMISTRY – III** Chemistry and Social Life		
Course Code	B-23-CHE-306		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MDC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	Higher Secondary other than Science Discipline		
Course Learning Outcomes (CLO):	• Students will learn about chemistry of daily used medicines, soap & detergents • Increase the literacy of chemistry even in non-science students • Understand the basic concept, principle and importance of chemistry • Realize the importance of chemistry in daily life and future requirement		
Credits	**Theory**	**Practical**	**Total**
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+25* Internal Assessment Marks:15+05* End Term Exam Marks:35+20*		**Time:03 + 03* Hrs**	

Part B- Contents of the Course	
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.	
Unit	**Topics**
I	**Basics of chemistry** **8 hours** Periodic table, Atom and molecules, chemical bonding, properties. Chemistry in Heritage: Extraction and uses of metals like iron and stone in ancient times, metals in ornaments, medicines, weapons and chemistry for preservatives, basics of preservation and few examples of preservatives.
II	**Chemistry in Life** **7 hours** Edible and non- edible molecules, biochemistry of foods and medicine with examples: Aspirin, Paracetamol. Ibuprofen and Penicillin, Cephalosporin, Chemistry for industry: Artificial sweeteners, Soaps and detergents and cosmetics, Polymer and Plastics: Uses and environmental issues.
III	**Testing of Chemicals** **8 hours** Flame test, solubility test, qualitative and quantitative identification of ions in natural samples like metal copper, iron and chromium ores and adulterant in foods. Chemical pollution/Toxicity: Chemical source of water, air and soil pollution, biomagnification and metal toxicity with example and illustrations. monitoring of air pollution.
IV	**Future of Chemistry** **7 hours** Basics of green chemistry, Reuse and recycling of by-products, zero waste chemistry and Alternate fuel and energy providing chemicals: biodiesel, natural gas and hydrogen.
V*	**30 hours** 1. Determine the calcium and magnesium contents in water samples using EDTA methods. 2. Determine the organic contents and pH of soil sample. 3. Estimate the food adulterants in edible items 4. Quantify the presence metals by flame test method 5. Demonstrate the exothermic and endothermic reaction in laboratory 6. Preparation aspirin and paracetamol as well as identify. 7. Demonstrate the protection of rusting of iron after surface spray coating.

	8. Estimate the protein contents in edible samples using chemical methods

Suggested Evaluation Methods	
Internal Assessment: 15+05* ➢ **Theory** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 07 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 05 • Mid-Term Exam: NA	**End Term Examination:** 35+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lee, J. D., Concise Inorganic Chemistry, Wiley India Pvt. Ltd.
2. Sharma, B. K., Industrial chemistry, Goel Publishing House, India
3. Christian, Gary D., Dasgupta, Purnendu K., Schug, Kevin A., Analytical chemistry, Wiley
4. V. Subramanian, A text book of Environmental chemistry, Wiley

**Applicable for courses having practical component.*

Course type-MCC-6

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**PHYSICAL CHEMISTRY – II** Thermodynamics and Colligative Properties		
Course Code	B-23-CHE-402		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties. • Derive the expressions of ΔU, ΔH, ΔS, ΔG, ΔA for an ideal gas under different conditions. • Understand the concept of partial molar properties. • Demonstrate different kinds of phase equilibrium. • Students will learn about existence of a substance in a given phase under different temperature and pressure values.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**Chemical Energetics** **11 hours** Recapitulation of Intensive and extensive variables; state and path functions; isolated, closed and open systems, concept of heat, Q, work, W, internal energy, U, and enthalpy, H. **First law:** Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities for ideal gas, Joule's experiment, calculations of Q, W, ΔU and ΔH for reversible expansion of ideal gases under isothermal conditions.
II	**Thermochemistry** **11 hours** Enthalpy of reactions: standard states; enthalpy of neutralization, enthalpy of ionization enthalpy of hydration, enthalpy of formation and enthalpy of combustion, Integral enthalpy of solution, bond dissociation energy and bond enthalpy; Hess's law, Born Haber's cycle (NaCl/ KCl). **Second Law:** Concept of entropy; statements of the second law of thermodynamics (Kelvin and Clausius). Calculation of entropy change for reversible processes (for ideal gases). Free Energy Functions: Gibbs and Helmholtz energy (Non-PV work and the work function); Free energy change and concept of spontaneity (for ideal gases).
III	**Third Law** **11 hours** Statement of third law, unattainability of absolute zero, calculation of absolute entropy of molecules, concept of residual entropy, calculation of absolute entropy of solid, liquid and gases. **Systems of Variable Composition:** Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, Change in thermodynamic functions on mixing of ideal gases.

IV	**Solutions and Colligative Properties** **12 hours** Dilute solutions; lowering of vapour pressure, Raoult's law, Henry's law. Thermodynamic basis of the colligative properties - lowering of vapour pressure, elevation of Boiling Point, Depression of Freezing point, Osmotic pressure and derivation of expressions for these using chemical potential. Application of colligative properties in calculating molar masses of normal, dissociated and associated solutes in solutions, Van't Hoff factor and its applications. Concept of activity and activity coefficients.	
V*	**30 hours** 1. Determination of critical solution temperature and composition at CST of the phenol water system 2. Determination of heat capacity of calorimeter. 3. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 4. Determination of the enthalpy of ionization of acetic acid. 5. Determination of enthalpy of neutralization of acetic acid and ammonium hydroxide using Hess's law. 6. Determination of integral enthalpy of solution (both endothermic and exothermic) of salts. 7. Determination of enthalpy of hydration of Copper sulphate.	

Suggested Evaluation Methods	
Internal Assessment: 20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Puri, B. R., Sharma, L. R. and Pathania M. S. (2020), Principles of Physical Chemistry, Vishal Publishing Co. 2. Castellan, G. W. (2004), Physical Chemistry, Narosa. 3. Kapoor, K. L. (2015), A Textbook of Physical Chemistry, Vol 1, 6th Edition, McGraw Hill Education. 4. Kapoor, K. L. (2015), A Textbook of Physical Chemistry, Vol 2, 6thEdition, McGraw Hill Education. 5. Khosla, B. D.; Garg, V. C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & Co. 6. Kapoor, K. L. (2019), A Textbook of Physical Chemistry, Vol 7, 1st Edition, McGraw Hill Education. 7. Batra, S. K., Kapoor, V and Gulati, S. (2017) 1st Edition, Experiments in Physical Chemistry, Book Age series.

**Applicable for courses having practical component.*

Course type-MCC-7

Session: 2024-255			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**General Chemistry-I:** General Spectroscopy		
Course Code	B-23-CHE-403		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Develop an understanding of quantum mechanical operators, quantization, probability distribution, uncertainty principle and application of quantization to spectroscopy. • Interpret various types of spectra and know about their application in structure elucidation • Understand how molecular spectroscopy techniques, UV, IR, NMR and Mass can be used to identify structures of organic compounds.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

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Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**11 Hours** Electromagnetic radiation, interaction of electromagnetic radiation with matter, regions of the Spectrum the width and intensity of spectral transitions. Resolving power. **Rotational Spectra**: The rotation of molecules, rotational spectra of diatomic molecules, the spectrum of non-rigid rotator, the effect of isotopic substitutions rotational spectra of linear and symmetric top polyatomic molecules.
II	***Vibrational and Vibrational- Rotational Spectra:*** **11 Hours** The vibrating diatomic molecule; simple harmonic vibrations, anharmonicity of vibrations, the diatomic vibrating rotator, the interaction of rotations and vibrations the vibrations of polyatomic molecules, analysis by infrared technique. ***Electronics Spectra:*** Electronic spectra of diatomic molecules, vibrational course structure, and rotational fine structure of electronic band. The Frank- Condon principle, intensity of vibrational-electronic band, dissociation energy, the Fortrat diagram.
III	***Raman Spectroscopy:*** **12 Hours** Quantum theory of Raman effect, Classical theory of Raman effect, Pure rotational Raman spectra, Raman activity of vibrations, vibrational Raman spectra, polarization of light and Raman effect, applications. Principles and Applications of UV and IR Spectra in the structure elucidation of Organic Compounds.
IV	*Vibrational and Vibrational- Rotational Spectra:* 11 Hours

IV	*NMR Spectra for Organic Compounds* Spin active nuclei, chemical shift, shielding and deshielding, internal standards, spin-spin coupling, equivalent and non- Equivalent Protons, effect of changing solvents and hydrogen bonding on chemical shifts, anisotropic effect. Applications in structure determination.	**12 Hours**
V*	*Qualitative Analysis* Identification of organic compound using spectroscopic methods (UV, IR, NMR & Mass) followed by characterization by chemical methods.	**30 hours**

Suggested Evaluation Methods

Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. R.S. Drago: Physical Methods in Inorganic Chemistry, affiliated east-west press pvt. Ltd.-New Delhi (2012).
2. C.N.Banwell: Fundamentals of Molecules Spectroscopy, McGraw Hill Education; 4th edition (2017).
3. D.L. Pavia, G.M. Lampman, G.S. Kriz and J.R. Vyvyan: Introduction to Spectroscopy, Cengage Learning India Private Limited; 5th edition (2015).
4. R.M. Silverstein, G.C. Bassler, and T.C. Morrill: Spectrometric Identification of Organic Compounds, John Wiley, 6th edition, (2002).
5. H. Middleton: Systematic Qualitative Organic Analysis, Edward Arnold & Co. (1948) .
6. H. Clark: Handbook of Organic Analysis-Qualitative and Quantitative, CBS, 4th revised edition (2007).

**Applicable for courses having practical component.*

Course type-MCC-8

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**General Chemistry-II:** Nuclear and Polymer Chemistry		
Course Code	B-23-CHE-404		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Gain knowledge about Nuclear chemistry, radioactive decay, nuclear disasters, and nuclear waste and their disposal. • Describe the composition of air, various air pollutants, effects and control measures of air pollutants. • List different sources of water, water quality parameters, impacts of water pollution, water treatment. • Identify different industrial effluents and their treatment methods.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	*Nuclear Chemistry:* **11 Hours** The nucleus: subatomic particles, e liquid drop model; forces in nucleus-mesons; stability of nucleus-n/p ratio, binding energy; radioactive elements. Radioactive decay- α-decay, β-decay, γ-decay; neutron emission, positron emission; unit of radioactivity (curie); half-life period; radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger Counters, Scintillation counters.
II	**Nuclear reactions**: **11 Hours** Nuclear fission-theory of nuclear fission; chain reaction; nuclear fusion; nuclear reactors-fast breeder reactors, fuels used in nuclear reactors, separation of isotopes, moderators, coolants; nuclear reactors in India. **Applications**: Dating of rocks and minerals, carbon dating, neutron activation analysis, isotopic labelling studies, nuclear medicine- 99mTc radiopharmaceuticals. Nuclear disasters – Chernobyl disaster, Three Mile Island Disaster, Disposal of nuclear waste and its management.
III	*Preparation, Properties and Uses of Polymers:* **12 Hours** Brief introduction to polymerisation, mechanism, properties and application of the following polymers: polyolefins, polystyrene, poly(vinyl chloride), poly(vinyl acetate), polyurethanes, acrylic polymers and polyamides. Phenol formaldehyde and urea formaldehyde, Silicone polymers, Conducting Polymers: polyacetylene, polyaniline, polypyrrole, polythiophene., Biopolymer: Cellulose and Chitosan.

IV	***Characterization of Polymers*** **12 Hours** Thermal characterisation of polymer: Glass transition temperature (Tg), thermal stability and decomposition of polymers, Molecular weight of polymers (Mn, Mw, etc.) by end group analysis, viscometry, light scattering technique and osmotic pressure methods. Structural characterisation of polymers by IR and NMR spectroscopy.	
V*	**30 hours** 1. Determination of dissolved oxygen in a given sample of water. 2. Determination of Chemical Oxygen Demand (COD) in a given sample of water. 3. Determination of Biological Oxygen Demand (BOD) in a given sample of water. 4. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate). 5. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method. 6. Measurement of dissolved CO_2 in a given sample of water.	
Suggested Evaluation Methods		
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Stanley E. Manahan, 10th edition, Environmental chemistry, CRC Press, Taylor and Francis Group, US, 2017
2. Baird, C. and Cann, M., Environmental Chemistry,(2012), Fifth Edition, W. H. Freemann & Company, New York, US.
3. Van Loon, G.W. and Duffy, J.S.(2018) Environmental Chemistry - A global perspective, Fourth Edition, Oxford University Press
4. Brusseau, M.L.; Pepper,I.L. and Gerba, C., (2019) Environmental and Pollution Science, Third Edition, Academic Press.
5. Masters, G.M., (1974) Introduction to Environmental Science and Technology, John Wiley & Sons.
6. Masters, G.M., (2015) Introduction to Environmental Engineering and Science. J Prentice Hall India Learning Private Limited.
7. Arnikar, H.J., (1987), Second Edition, Essentials of Nuclear Chemistry, Wiley Blackwell Publishers
8. Arnikar, H.J.; Rajurkar, N. S.,(2016) Nuclear Chemistry through Problems, New Age International Pvt. Ltd.
9. De, A.K.(2012), Environmental Chemistry, New Age International Pvt., Ltd.
10. Khopkar, S.M.(2010), Environmental Pollution Analysis, New Age International Publisher.
11. Das, A. K. (2010), Fundamentals of Inorganic Chemistry, Volume 1, Second Edition, CBS Publishers & Distributors Pvt Ltd.
12. Das, A. K. (2012), Environment Chemistry with Green chemistry, Books and Allied (P) Ltd.
13. Vowles, P.D.; Connell, D.W. (1980), Experiments in Environmental Chemistry: A Laboratory Manual, Vol.4, Pergamon Series in Environmental Science.
14. Gopalan, R.; Anand, A.; Sugumar R.W. (2008), A Laboratory Manual for Environmental Chemistry, I. K. International.

**Applicable for courses having practical component.*

Course type- DSE-1

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**Elective Chemistry-I (Inorganic Chemistry):** Environmental Chemistry		
Course Code	B-23-CHE-405 (E1)		
Course Type: (MCC/CC/MDC /DSEC/DSE/VOC/DSE/PC/AEC/ VAC)	DSE		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Synthesize knowledge on the structure and functions of environmental compartments based on the principles of environmental chemistry • Acquire analytical and technical skills to recognize and estimate different environmental chemicals • Apply concepts of environmental chemistry to develop low-cost methods to treat potable and industrial wastewater and manage the quality of water, soil, and air • Relate and interpret the contaminants exposure and its adverse impacts on living organisms and the health of ecosystems • influence the environmental fate of contaminants • Discuss global environmental issues in the background of the chemistry of pollutants		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

SECTION and one question (Question No.1) based on entire syllabus will consist of short answer

Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	*Fundamentals of environmental chemistry:* **12 Hours** Atomic structure, electronic configuration, periodic properties of elements (ionization potential, electron affinity and electronegativity), types of chemical bonds (ionic, covalent, coordinate and hydrogen bonds); mole concept, molarity and normality, quantitative volumetric analysis. *Thermodynamic system;* types of chemical reactions; acids, bases and salts, solubility products; solutes and solvents; redox reactions, concepts of pH and pE, electrochemistry, Nernst equation, electrochemical cells. Basic concepts of organic chemistry, hydrocarbons, aliphatic and aromatic compounds, organic functional groups, polarity of the functional groups, synthesis of xenobiotic compounds like pesticides and dyes, synthetic polymers.
II	*Air Pollution* **10 Hours** Composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), aerosols; chemistry of acid rain, case studies; reactions of NO_2 and SO_2; free radicals and ozone layer depletion, role of CFCs in ozone depletion. ***Chemistry and environment impact of the following:*** Photochemical smog, Greenhouse effect, Ozone depletion Air pollution control, Settling Chambers, Venturi Scrubbers, Electrostatic Precipitators (ESPs).
III	*Water Chemistry* **6 Hours** Chemical and physical properties of water; alkalinity and acidity of water, hardness of water, calculation of total hardness; solubility of metals, complex formation and chelation; colloidal particles; heavy metals in water Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).

IV	***Soil chemistry*** ***6 Hours*** Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium in soil; phenolic compounds in soil. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion-exchange). Water quality parameters for wastewater, industrial water and domestic water.
V*	**30 Hours** 1. Prepare buffers/solutions of different molarity and normality using the given stocks solutions 2. Determine the variations in pH of different soils and water samples using various methods. 3. Estimate hardness of given water samples 4. Determine cation exchange capacity of given soils samples 5. Determine the suitability of water for use for agriculture, industrial and domestic purposes based on selected water parameters 6. Estimate contents of selected heavy metals in given water and soil samples and identify their possible sources 7. Analyse variations in air quality index of different regions and correlate with anthropogenic or natural factors 8. Estimate organic matter contents in different soil types 9. Assess soil health based on the concentration of selected macro elements

Suggested Evaluation Methods	
Internal Assessment: 20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*
Part C-Learning Resources	

Recommended Books/e-resources/LMS:

1. Beard, J.M. 2013. **Environmental Chemistry in Society** (2nd edition). CRC Press.
2. Connell, D.W. 2005. **Basic Concepts of Environmental Chemistry** (2nd edition). CRC Press.
3. Harnung, S.E. & Johnson, M.S. 2012. **Chemistry and the Environment**. Cambridge University Press.
4. Hites, R.A. 2012. **Elements of Environmental Chemistry** (2nd edition). Wiley Sons.
5. Manhan, S. E. 2000. **Fundamentals of Environmental Chemistry**. CRC Press.
6. Pani, B. 2007. Textbook of **Environmental Chemistry**. IK international Publishing House.
7. Girard, J. 2013. Principles of **Environmental Chemistry** (3rd edition). Jones & Bartlett.

**Applicable for courses having practical component.*

Course type- DSE-1

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**Elective Chemistry-II (Organic Chemistry):** Organic Biomolecules		
Course Code	B-23-CHE-405 (E2)		
Course Type: (MCC/CC/MDC /DSEC/DSE/VOC/DSE/PC/AEC/ VAC)	DSE		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Learn and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses. • Gain an insight into the mechanism of enzyme action and inhibition. • Understand the basic principles of drug-receptor interaction and SAR.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*		**Time:03 + 03***	

Part B- Contents of the Course	
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.	
Unit	**Topics**
I	*Carbohydrates* ***12 Hours*** Classification of carbohydrates, reducing and non-reducing sugars, biological functions, general properties and reactions of glucose and fructose, their open chain structure, epimers, mutarotation and anomers, reactions of monosaccharides, determination of configuration of glucose (Fischer proof), cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosaccharides: structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.
II	**Amino Acids, Peptides and Proteins** **11 Hours** Classification of amino acids and biological uses of amino Acids, peptides and proteins. Zwitterion structure, isoelectric point and correlation to acidity and basicity of amino acids. Determination of primary structure of peptides, determination of N-terminal amino acid (by Edman method) and C– terminal amino acid (with carboxypeptidase enzyme). Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyloxycarbonyl) & C-activating groups (only DCC) and Merrifield solid phase synthesis, Overview of primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins.
III	*Nucleotides* ***11 Hours*** Sugars and bases; Conformation of sugar-phosphate backbone; hydrogen bonding by bases; the double helix; A, B, and Z double helices; Stability of Double Helix; DNA intercalators; Chemical synthesis of DNA. ***Lipids:*** Fatty acids, triacylglycerols, phospholipids, lipid bilayer formation, steroids (cholesterol)
IV	*Enzymes and correlation with drug action:* ***11 Hours*** Classification of enzymes and their uses (mention Ribozymes). Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and non-competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure – activity relationships of drug molecules, binding role of –OH group, -NH2 group, double bond and aromatic ring.

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V*	**30 hours** 1. Estimation of glucose by Fehling's solution. 2. Determination of total sugar content by ferricyanide method (volumetric/colorimetric method). 3. Study of the titration curve of glycine. 4. Qualitative tests for amino acids, proteins and carbohydrates. 5. Separation and identification of mixture of sugars by paper chromatography.	

Suggested Evaluation Methods

Internal Assessment: 20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Finar, I. L. **Organic Chemistry** (Volume 1 & 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Berg, J. M.; Tymoczko, J. L.; Stryer, L. (2019), **Biochemistry**, 9th Ed., W. H. Freeman Co Ltd.
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), Vogel's Textbook of **Practical Organic Chemistry**, Pearson.
5. **Manual of Biochemistry** Workshop, 2012, Department of Chemistry, University of Delhi.

**Applicable for courses having practical component.*

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Course type- DSE-1

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**Elective Chemistry-III (Physical Chemistry):** Phase Equilibria and Surface Chemistry		
Course Code	B-23-CHE-405 (E3)		
Course Type: (MCC/CC/MDC /DSEC/DSE/VOC/DSE/PC/AEC/ VAC)	DSE		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Explain different types of phase equilibrium, draw a well labelled phase diagram. • Predict the existence of a substance in a given phase under different conditions of temperature and pressure • Apply the concepts of phase, solutions and distribution law while studying other chemistry courses and every-day life processes. • Explain the type of adsorption that can take place in different systems and predict the conditions to get maximum adsorption.		
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	45	30	75

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Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time:03 + 03*

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type). All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	**Phase Equilibria-I** *12 Hours* Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (H_2O and S), with applications. A comparison between the phase diagram of CO_2 and H_2O. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions (excluding partial miscibility).
II	***Phase Equilibria-II*** **11 Hours** Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), Konovalov's laws, azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications. Three component systems, water-chloroform-acetic acid system, triangular plots.
III	***Surface Chemistry*** *11 Hours* Distinction between adsorption and absorption, Physical adsorption: chemisorption, adsorption isotherms (Langmuir and Freundlich). Nature of adsorbed state. Multilayer adsorption, BET equation derivation, thermodynamic treatment of adsorption-Gibbs equation. Applications of Adsorption phenomenon in living systems.
IV	***Colloidal State*** *11 Hours* Distinction among true solutions, colloids and suspensions, components of Colloids, classification of colloids - lyophilic, lyophobic; Preparation methods and properties of lyophobic solutions, Hydrophile-lyophile balance (HLB), multi molecular, macromolecular and associated colloids (micelles formation), Schulze -Hardy law.

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V*	**30 hours** 1. Determination of critical solution temperature and composition at CST of the phenol water system 2. To study the effect of impurities of sodium chloride and succinic acid on the CST of phenol-water system. 3. To study the cooling curves for the following systems: a. Simple eutectic b. Congruently melting systems. 4. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Suggested Evaluation Methods

Internal Assessment:20+10*	**End Term Examination:**
➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Peter, A.; Paula, J. de. (2011), Physical Chemistry, 9th Edition, Oxford University Press.
2. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
3. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th Edition, McGraw Hill Education.
4. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 5, 6th Edition, McGraw Hill Education.
5. Ball, D. W. (2017), Physical Chemistry, 2nd Edition, Cengage Learning, India.
6. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & Co, New Delhi.
7. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York.
8. Levine, I.N. (2010), Physical Chemistry, Tata Mc Graw Hill.

**Applicable for courses having practical component.*

Course type-CC-M4(V)

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**Green Chemistry**		
Course Code	B-23-CHE-204		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	VOC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Understand the twelve principles of green chemistry and also build the basic understanding of toxicity, hazard and risk related to chemical substances. • Calculate atom economy, E-factor and relate them in all organic synthesis • Appreciate the use of catalyst over stoichiometric reagents. Learn to use green solvents, renewable feedstock and renewable energy sources for carrying out safer chemistry • Appreciate the use of green chemistry in problem solving skills and critical thinking to innovate and find solutions to environmental problems. • Learn to design safer processes, chemicals and products through understanding of inherently safer design (ISD) • Appreciate the success stories and real-world cases as motivation for them to practice green chemistry		
Credits	**Theory**	**Practical**	**Total**
	3	1	4

Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*		Time:03 + 03*	

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	*Introduction* — *10 Hours* Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry. ➢ Need of green chemistry ➢ Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each). ➢ A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards).
II	*Twelve Principles of Green Chemistry:* — *12 Hours* The twelve principles of the Green Chemistry with their explanations, Special emphasis on the following: • Prevention of waste / byproducts, pollution prevention hierarchy. • Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy. • Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources. • Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysts, asymmetric catalysis and photocatalysis. • Green energy and sustainability. • Real-time analysis for pollution prevention. • Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.

III	***Important Applications of Green Chemistry Principles:*** ***12 Hours*** Concept familiarization and application of green chemistry principles using specific examples 1. Prevention of waste/ by products; waste or pollution prevention hierarchy 2. Green metrics to assess greenness of a reaction: Calculation of atom economy of the rearrangement, addition, substitution, and elimination reactions; calculation of E-factor for industrial processes 3. Prevention/ minimization of hazardous/ toxic products 4. Safer Solvent and Auxiliaries: Problems associated with conventional reaction media Some Common Green solvents: Introduction, application, advantages, and disadvantages of green solvents in organic synthesis (taking suitable examples). Special emphasis on the following: i. Super Critical Fluids (with special reference to carbon dioxide) ii. Water: Concept of In-water, and on-water reactions (with special reference to synthesis of terpinol and linalool in water, Benzoin condensation, Heck reaction) iii. Ionic Liquids: Physical properties and classification of Ionic Liquids (with special reference to Diels Alder reaction and Coumarin synthesis in ionic liquids) iv. Biomass derived Solvents: Physicochemical properties, Use of glycerol and its derivatives (Mizoroki–Heck reaction) and 2-methyltetrahydrofuran (Suzuki–Miyaura reaction). 5. Use of renewable starting materials: Illustrate with few examples such as biodiesel, bioethanol, polymers from renewable resources (PLA from corn), Synthesis and properties of 2-Methyltetrahydrofuran, furfural and 5-Aminolevulinic acid (DALA) from levulinic acid
IV	**11 Hours** The following Real-world Cases in green chemistry should be discussed: Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.
V*	**30 hours** Characterization by melting point, UV-Visible spectroscopy, IR spectroscopy and any other specific method should be done (wherever applicable). 1. Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts. 2. Preparation of biodiesel from waste cooking oil and characterization (TLC, pH, solubility, combustion test, density, viscosity, gel formation at low temperature and IR can be provided). 3. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice. 4. Mechanochemical solvent free, solid-solid synthesis of azomethine using ptoluidine and o-vanillin/p-vanillin. 5. Photoreduction of benzophenone to benzopinacol in the presence of sunlight. 6. Photochemical conversion of dimethyl maleate to dimethyl fumarate (cis-trans isomerisation)

Suggested Evaluation Methods	
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Anastas, P.T., Warner, J.C. (2014). Green Chemistry. Theory and Practice. Oxford University Press.
2. Lancaster, M. (2016). Green Chemistry: An Introductory Text, 3rd Edition, RSC Publishing.
3. Cann, M. C., Connely, M.E. (2000). Real-World cases in Green Chemistry. American Chemical Society, Washington.
4. Matlack, A.S. (2010). Introduction to Green Chemistry, 2nd Edition. Boca Raton: CRC Press/Taylor & Francis Group publisher.
5. Alhuwalia, V.K., Kidwai, M.R. (2005). New Trends in Green chemistry. Anamalaya Publishers.
6. Sidhwani, I.T, Sharma, R.K. (2020). An Introductory Text on Green Chemistry. Wiley India Pvt Ltd.
7. Kirchoff, M.; Ryan, M.A. (2002). Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC.
8. Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K. (2013). Green Chemistry Experiments: A monograph. I.K. International Publishing House Pvt Ltd. New Delhi.
9. Pavia, D.L.; Lamponam, G.H.; Kriz, G.S.W. B. (2012). Introduction to organic Laboratory Technique- A Microscale approach, 4th Edition. Brooks-Cole Laboratory Series for Organic chemistry.
10. Sidhwani I.T. (2015), Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. DU Journal of Undergraduate Research and Innovation, 1(1),131-151. ISSN: 2395-2334.
11. Sidhwani, I.T; Sharma, R.K. (2020). An Introductory Text on Green Chemistry. Wiley India Pvt Ltd.
12. Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, Department of Science and Technology, Government of India.

**Applicable for courses having practical component.*

MCC-9

Session: 2025-26

Part A- Introduction

Subject	Chemistry		
Semester	V		
Name of Course	**Inorganic Chemistry-III**		
Course Code	B-23-CHE-502		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	MCC		
Level of Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. List the important properties of transition metals, lanthanoids, and actinoids 2. List and use the principles of gravimetric analysis for quantitative analysis 3. Explain the meaning of the terms Δo, Δt, pairing energy, CFSE, high spin and low spin complexes and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy. 4. Explain magnetic properties and colour of complexes on the basis of Crystal FieldTheory. 5. Able to explain kinetic and thermodynamic stability of inorganic reactions. 6. *Hand on practice in preparation of metal complexes, identification of organic and measurement of surface tension of solutions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		

Part B- Contents of the Course

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Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Transition Elements:** General group trends with special reference to electronic configuration, colour, variable valency, magnetic properties, catalytic properties, and ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer diagrams), Frost diagrams of Mn and Cr. A brief discussion of differences between the first, second and third transition series	11
II	**Lanthanoids and Actinoids:** A brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties. Lanthanoid contraction (causes and effects) separation of lanthanoids by ion exchange method.	11
III	**Coordination Chemistry:** Werner's Coordination theory, simple problems based on this theory IUPAC nomenclature of coordination compounds, isomerism in coordination compounds (coordination numbers 4 and 6). Valence bond theory and its application to complexes of coordination numbers 4 and 6. Crystal field theory, measurement of Δo. Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δo. Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry: Jahn-Teller theorem, square planar geometry.	11

IV	**Stability of complexes and Inorganic Reaction Mechanism:** Brief discussion of thermodynamic and kinetic stability, Factors affecting stability of complexes, such as chelate effect, macrocyclic effect, resonance effect etc., trends in step wise formation constant, interpretation of lability and inertness based on VBT and CFT. Substitution reactions in square planar complexes, factors affecting the rate of Substitution reactions in square planar complexes- such as charge effect, solvent effect and Trans- effect (Theories of trans-effect).	12
V*	**(A) Gravimetry** 1. Estimation of Ni(II) using dimethylglyoxime (DMG). 2. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$. 3. Estimation of Al(III) by precipitating with oxime and weighing as Al(oxime)3 (aluminiumoxinate). **(B) Complexometric Titrations:** (i) Complexometric estimation of Mg^{2+}/ Zn^{2+} using EDTA (ii) Estimation of total hardness of water samples (iii) Estimation of Ca^{2+} in solution by substitution method	30

Suggested Evaluation Methods

Internal Assesment:20+10*

Theory

- Class Participation: 5
- Seminar/Presentation/Assignment/Quiz/ Class Test etc: 5
- Mid Term Exam: 10

Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc: 10
- Mid-Term Exam: NA

End Term Examination:

50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Lee, J.D.(2010),ConciseInorganicChemistry,WileyIndia.
2. Huheey,J.E.;Keiter,E.A.;Keiter;R.L.;Medhi,O.K.(2009),InorganicChemistry- Principles of Structure and Reactivity,Pearson Education.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
4. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.
5. Pfennig, B. W. (2015), Principles of Inorganic Chemistry. John Wiley & Sons.
6. Cotton, F.A.; Wilkinson, G. (1999), Advanced Inorganic Chemistry, Wiley-VCH.
7. Das, A. K.; Das, M. (2014), Fundamental Concepts of Inorganic Chemistry, 1st Edition, Volume 1-3, CBS Publishers & Distributors Pvt. Ltd.
8. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons,
9. Day, R. A.; Underwood, A. L. (2012), Quantitative Analysis, Sixth Edition, PHI Learning Private Limited.

*Applicable for courses having practical component.

MCC-10

Session: 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	**Organic Chemistry –III**		
Course Code	B-23-CHE-503		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	MCC		
Level of Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the fundamentals of polynuclear hydrocarbons and heterocyclic compounds through the study of methods of preparation, properties and chemical reactions with under lying mechanism. 2. Classify and name heterocyclic compounds. 3. Analyze the important synthetic routes, physical properties, chemical properties and reactivity of five and six membered heterocyclic compounds. 4. Explain the heterocyclic structures in biologically active compounds. 5. Apply the study of heterocyclic compounds in medicine, agrochemicals, dyes and pigments, plastics and polymers. 6. *Hand on practice in preparation of metal complexes, identification of organic and measurement of surface tension of solutions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		
Part B- Contents of the Course			

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1)) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Polynuclear Hydrocarbons** Introduction, classification, uses, aromaticity of polynuclear compounds, Structure elucidation of naphthalene, preparation and properties of naphthalene and anthracene.	11
II	**Introduction and Nomenclature:** Introduction and classification of heterocyclic compounds. Nomenclature: Trivial names of common ring systems, Systematic (Hantzsch-Widman) nomenclature for heterocyclic compounds, naming of fused ring systems and Replacement nomenclature.	11
III	**General Properties and Synthesis of Five and Six Membered Heterocyclic Compounds:**General discussion on the following aspects of five and six membered heterocyclic compounds containing one heteroatom: Structure, aromaticity, basicity, physical properties and general methods of synthesis of Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene and Pyridine (Hantzsch synthesis).	11
IV	**Reactions of Five Membered Heterocyclic Compounds:** Furan, Pyrrole, Thiophene: Orientation and reactivity towards electrophilic substitution reactions with mechanism. Discussion on the following reactions: Nitration, sulphonation, halogenation, formylation, acylation, mercuration and carboxylation. Reactions exhibiting acidic/basic character. Oxidation, reduction and addition reactions. Diels-Alder reaction, reaction with diazonium salt. Pyridine: Electrophilic substitution, nucleophilic substitution, oxidation and reduction reactions.	12

V*	Preparation of Organic compounds and recrystallized that to report melting point. 1. Synthesis of oxygen containing heterocyclic compounds: a. Phthalic anhydride (b) 7- Hydroxy-4-methylcoumarin 2. Synthesis of nitrogen containing heterocyclic compounds: a. Phthalimide (b) Phthaloylglycine 3. Synthesis of Imidazole derivatives: a. Benzimidazole (b) 2-Benzylbenzimidazole (c) 2- Methylbenzimidazole 4. Synthesis of Pyrazole derivatives: a. 3-Methyl-2-pyrazolin-5-one (b) 3, 5-Dimethylpyrazole 5. Synthesis of Pseudothiohydantoin	30

Suggested Evaluation Methods

Internal Assesment:20+10*

Theory

- Class Participation: 5
- Seminar/Presentation/Assignment/Quiz/ Class Test etc: 5
- Mid Term Exam: 10

Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc: 10
- Mid-Term Exam: NA

End Term Examination: 50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Morrison, R. N., Boyd, R. N., Bhattacharjee, S.K. (2010), Organic Chemistry, 7th Edition, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
2. Finar, I.L. Organic Chemistry Volume 1, Dorling Kindersley (India) Pvt. Ltd.,Pearson Education.
3. Finar, I.L. Organic Chemistry Volume 2, Dorling Kindersley (India) Pvt. Ltd.,Pearson Education.
4. Mehta Bhupinder and Mehta Manju (2015) "*Organic Chemistry*" *2nd Edn.*, PHI Learning Pvt. Ltd. New Delhi. ISBN-978-81-203-5126-4.
5. Bansal Raj K "*Heterocyclic Chemistry*" *5th Ed*, New Age International Publishers. ISBN 978-81-224-3143-8.
6. J. A. Joule, K. Mills and G. F. Smith, "*Heterocyclic Chemistry*" *5th Edn.*, Wiley International Publications. ISBN: 978-1-4051-3300-5.
7. Thomas. L. Gilchrist "*Heterocyclic Chemistry*" *3rd Edn.*, Prentice Hall Publication. ISBN 978- 0-5822-7843-1.
8. T. W. Graham Solomons, "*Organic Chemistry*" 12th Edn., John Wiley. ISBN-10: 1118133579.
9. A.O. Fitton and R.K. Smalley, "*Practical Heterocyclic Chemistry*" 1st Edn., Academic Press. ISBN:9781483270791.
10. Furniss, B.S.; Hannaford, A.J.: Smith, P.W.G.; Tatchell, A.R. (2012), "*Vogel's Textbook of Practical Organic Chemistry*", Pearson.
11. Mann, F.G.; Saunders, B.C. (2009), "*Practical Organic Chemistry*", Pearson. India

*Applicable for courses having practical component.

DSE-2

Session: 2025-26			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	**Elective chemistry –IV (Inorganic Chemistry)**		
Course Code	B-23-CHE-504 (E4)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Establish an appreciation of the role of inorganic chemistry in the chemical sciences. 2. Analyse inorganic materials like silicates, ceramics and cement. 3. Familiarized with scientific method of planning, developing, conducting, reviewing 4. and reporting experiments. 5. Draw various concepts of industrial metallurgy which will help them to explore 6. new innovative areas of research. 7. Explain scientific methods employed in inorganic chemistry.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03 + 03* Hours		
Part B- Contents of the Course			

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Silicate Industries:** (a) *Glass*: Glassy state and its properties, Classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, and photosensitive glass. (b) *Ceramics*: Ceramic, their types and manufacture. High technology ceramics and their applications. fullerenes carbon nanotubes and carbon fiber, clays and feldspar. (c) *Cement*: Classification of cement, ingredients and their role. Manufacture of cement and the setting process, quick setting cements.	12
II	Brief introduction to and classification of surface coatings, paints and pigments: formulation, composition and related properties, pigment volume concentration (PVC)and critical pigment volume concentration (CPVC), fillers, thinners, enamels and emulsifying agents. Special paints: heat retardant, fire retardant, eco-friendly paints, plastic paints, water and oil paints. Preliminary methods for surface preparation, metallic coatings (electrolytic and electroless with reference to chrome plating and nickel plating), metal spraying and anodizing.	11
III	**Fertilizers**: Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved in the manufacture of the following fertilizers: urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime, potassium chloride and potassium nitrate.	11
IV	**Medical Applications of Inorganic Compounds:** Introduction, Use of Chelating agents, metal complexes as diagnostic agents, Lithium in mental health, Gold containing drugs, role of metals in Neurodegenerative Diseases, Inorganic compounds in Chemotherapy: Cisplatin; mode of action, basic idea of second and third generation drugs	11

V*	**PRACTICAL (Any Four)** 1. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content. 2. Detection of constituents of Superphosphate fertilizer (Calcium and Phosphate ions) and estimation of phosphoric acid content. 3. Analysis of (Cu, Zn) in alloy or synthetic samples (Multiple methods involving Iodometry, and Potentiometry). 4. Synthesis of pure ZnO and Cu doped ZnO nanoparticles. 5. Synthesis of silver nanoparticles by green and chemical approach methods and its characterization using UV-visible spectrophotometer 6. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.	30

Suggested Evaluation Methods

Internal Assessment:20+10*

Theory

- Class Participation: 5
- Seminar/presentation/assignment/quiz/class test etc.: 5
- Mid-Term Exam: 10

Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc.: 10
- Mid-Term Exam: NA

End Term Examination : 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. West, A. R. (2014),Solid State Chemistry and Its Application, Wiley
2. Smart, L. E.; Moore, E. A. (2012),Solid State Chemistry An Introduction, CRC Press Taylor & Francis.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A.(2010),Shriver and Atkins Inorganic Chemistry, W. H. Freeman and Company.
4. Kent, J. A. (ed) (1997), Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. Poole Jr.; Charles P.; Owens, Frank J.(2003), Introduction to Nanotechnology, John Wiley and Sons.
6. Svehla, G.(1996),Vogel's Qualitative Inorganic Analysis, Prentice Hall.
7. Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.
8. Ghorbani, H. R.; Mehr, F.P.; Pazoki, H.; Rahmani B. M. Synthesis of ZnO Nanoparticles by Precipitation Method. Orient J Chem 2015;31(2). Press.

*Applicable for courses having practical component.

DSE-2

Session: 2025-26			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	**Elective chemistry –V (Organic Chemistry)**		
Course Code	B-23-CHE-504 (E5)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Know about history of polymeric materials and their classification 2. Learn about different mechanisms of polymerization and polymerization techniques 3. Learn about different methods of finding out average molecular weight of polymers 4. Differentiate between glass transition temperature (Tg) and crystalline melting point (Tm) 5. Determine Tg and Tm 6. Learn properties and applications of various useful polymers in our daily life. 7*. Hand on practice to synthesize various compounds and determination of their melting points.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03 + 03* Hours		
Part B- Contents of the Course			

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Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non- programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Introduction to Polymeric Materials:** History of polymeric materials, Different schemes of classification of polymers, Polymer nomenclature Molecular forces and chemical bonding in polymers, Physical and chemical properties of polymers Solubility and Criteria for polymer solubility, Texture of Polymers, modification of polymers, Structure and property relationships, Introduction to conducting and biodegradable polymers.	12
II	**Characterization of Polymers:** Thermal characterisation of polymer: Glass transition temperature (Tg), thermal stability and decomposition of polymers, Molecular weight of polymers (Mn, Mw, etc.) by end group analysis, viscometry, light scattering technique and osmotic pressure methods. Structural characterisation of polymers by IR and NMR spectroscopy.	11
III	**Preparation, Properties and Uses of Polymers:** Brief introduction to polymerisation, mechanism, properties and application of the following polymers: polyolefins, polystyrene, poly(vinyl chloride), poly(vinyl acetate), polyurethanes, acrylic polymers and polyamides. Phenol formaldehyde and urea formaldehyde, Silicone polymers, Conducting Polymers: polyacetylene, polyaniline, polypyrrole, polythiophene., Biopolymer: Cellulose and Chitosan.	11
IV	**Dyes:** Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing. Synthesis and applications of Azo dyes – Methyl orange, Congo red; Triphenyl methane dyes- Crystal violet; Phthalein Dyes – Phenolphthalein; Natural dyes –Structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.	11

V*	**(Perform Any six)** **1.** Preparation of nylon 6,6. **2.** polymerization of acrylonitrile. **3.** Preparation of urea-formaldehyde resin. **4.** Preparations of phenol-formaldehyde resin. **5.** Estimation of the amount of HCHO in the given solution by sodium sulphite method. **6.** Demonstration for chemical structure and functional group in polymers using IR spectroscopy. **7.** Polymerization of aniline and pyrrole by chemical polymerisation method. **8.** Preparation of Methyl Orange. 9. Preparation of Malachite Green.	30

Suggested Evaluation Methods

Internal Assessment:20+10*

Theory

- Class Participation: 5
- Seminar/presentation/assignment/quiz/class test etc.: 5
- Mid-Term Exam: 10

Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc.: 10
- Mid-Term Exam: NA

End Term Examination:

50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Ahluwalia V.K. & Mishra A. Polymer Science :A Textbook(2009) Anne Books.
2. Odian, G. (2004), Principles of Polymerization, John Wiley.
3. Billmeyer, F.W. (1984),Text Book of Polymer Science,3rd Ed., John Wiley.
4. Ghosh, P. (2001),Polymer Science & Technology, Tata Mcgraw-Hill.
5. Lenz, R.W. (1967),Organic Chemistry of Synthetic High Polymers, Interscience (Wiley).
6. Hundiwale ,D.G.,Athawale V.D ,Kapadi, U.R.& Gite V.V, Experiments in Polymer Science ,New Age International Publishers .
7. Allcock, H.R.; Lampe, F. W.; Mark, J. E. (2003), Contemporary Polymer Chemistry, Prentice-Hall.
8. Fried, J.R. (2003), Polymer Science and Technology, 2nd Ed, Prentice-Hall.
9. Munk, P.; Aminabhavi , T. M. (2002), Introduction to Macromolecular Science, John Wiley & Sons.
10. Sperling, L.H. (2005), Introduction to Physical Polymer Science, John Wiley & Sons.

*Applicable for courses having practical component.

DSE-3

Session: 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	**Elective chemistry –VI (Physical Chemistry)**		
Course Code	B-23-CHE-505 (E6)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Explain the types of polymers, kinetics of polymerization and polymer properties. 2. Understand and apply the concepts of properties of polymer solutions and their thermodynamics. 3. Comprehend the basic concepts of surface chemistry specifically in relation to colloids. 4. Have a thorough understanding of applications of colloids in various areas. 5*. Hand on practice in the investigations of distribution of solute in different solvents, degree of hydrolysis of organic salts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		
Part B- Contents of the Course			

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Introduction to polymers:** Recapitulation of basic concepts of polymers. Types of polymerizations and their mechanism and kinetics: Free radical, ionic, step-growth, coordination, copolymerization. Polymerization techniques: Bulk, solution, suspension, and emulsion. **Polymer solution:** solubility parameter, properties of dilute solutions and their criteria, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change. Flory Huggins theory.	11
II	**Introduction to Colloid Chemistry:** Recapitulation of basic concepts of Adsorption, Distinction among true solutions, colloids and suspensions, Components of Colloids, classification of colloids - lyophilic, lyophobic; Preparation methods and properties of lyophobic solutions, Hydrophile-lyophile balance (HLB), multi molecular, macromolecular and associated colloids (micelles formation), preparation and properties of colloids - Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation and flocculation; Charge on Colloidal particles and Electrical double layer concept. Suspensions, Emulsions and their characteristics.	11
III	**Surface chemistry in relation to colloids** Surface film on liquid surface, surface potential, monomolecular films, Langmuir Blodgett layers. Emulsions, foams and aerosols; electrical aspects of surface chemistry; Surface of solids, solid-liquid interface, stability of dispersions, stabilization of suspensions	11
IV	**Application of colloids:** Characterization of colloidal particles, Role of colloid chemistry in Nanotechnology (wet colloid chemical approach, "bottom up" fabrication of nanoparticles and nanostructured materials), applications of colloid chemistry in petroleum recovery, coating and painting, food, pharmaceuticals and cosmetic industry, medicinal chemistry (use in drug formulations), Sewage disposal, Purification of water, cleansing action of soap.	12

V*	1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate(MMA)/MethylAcrylate (MA). 2. Preparation of nylon 6,6 3. Determination of molecular weight of polyvinyl propylidene in water by viscometry. 4. Determination of the viscosity-average molecular weight of poly(vinyl alcohol)(PVOH) and the fraction of head-to-head monomer linkages in the polymer. 5. Determination of molecular weight by end group analysis of polymethacrylic acid. 6. Estimation of the amount of HCHO in the given solution by sodium sulphite method. 7. Preparation of Colloidal Sols of following A. Arsenic sulphide, B. Antimony sulphide C. Ferric chloride D. Aluminium hydroxide 8. To find out the precipitation values of arsenious sulphide sol by using monovalent, bivalent and trivalent cations. 9. To determine the nature of charge on particle in given colloidal solution and their electrophoretic velocity and zeta potential. 10. To prepare lyophilic sol of starch.	30

Suggested Evaluation Methods

Internal Assesment:20+10*

Theory

- Class Participation: 5
- Seminar/Presentation/Assignment/Quiz/Class Test etc: 5
- Mid-Term Exam: 10

Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc: 10
- Mid-Term Exam: NA

End Term Examination:

50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Carraher,C. E. Jr. (2013), Seymour's Polymer Chemistry, Marcel Dekker, Inc.
2. Odian, G. (2004), Principles of Polymerization, John Wiley.
3. Billmeyer, F.W. (1984), Text Book of Polymer Science, John Wiley
4. Myers D.,Surface, interfaces and colloids Principles and Applications, 2nd Edition,Wiley- VCH
5. V.R. Gowarikar (2010), Polymer Science, New Age International Publishers Ltd.
6. Sperling, L.H. (2005), Introduction to Physical Polymer Science, John Wiley & Sons

*Applicable for courses having practical component.

DSE-3

Session: 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	**Elective chemistry –VII (Analytical Methods in Chemistry)**		
Course Code	B-23-CHE-505 (E7)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Familiar with interpretation and use of analytical data collected by different techniques, significance of different analytical techniques and their applications, reliability and presentation of data for reporting to different forum. 2*. Hand on practice in the investigations of distribution of solute in different solvents, degree of hydrolysis of organic salts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03*		
Part B- Contents of the Course			

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Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Basics of Chemical Analysis:** Analytical Chemistry, Qualitative and quantitative analysis, Analytical methodology. Calibration of glass wares, recording laboratory data. **Different Methods of Chemical Analysis:** Titrimetric method: volumetric titremetry, standard solution, titrimetric curve, calculation; Gravimetric method: precipitation gravimetry, calculation and applications of gravimetry; and Spectrometric methods: introduction, principle and instrument, working quantitative aspects absorbance, applications in chemical analysis	11
II	**Statistical Method of Chemical Analysis:** Accuracy and Precision, Comparison of precision, Errors, Distribution of random errors, propagation of errors, measurement of errors, significant figure, inter laboratory error, methods of least square analysis of variance, Q test, Z test, T test, statistical treatment of finite sample, recommendations for treating outliers. Minimising errors in analytical procedure.	11
III	**Data Analysis and Validation:** Confidence interval, Testing of hypothesis, plotting of data, least square method, Figures of merit: sensitivity, detection limit, linear dynamic range, control test, upper control limit and lower control limit, Validation, reporting analytical results and significant figures	12
IV	**Sampling, Standardisation, Labelling and Calibration:** Analytical samples, sample size, constituent sample, real samples, sample, sample handling, preparing laboratory samples, automated sample handling, lab on chip and General laboratory principles, recording laboratory data, standards, comparison of standards, internal standard, external standards calibration, least square method, and multivariant calibration.	11

V*	1. Calibrate the volume of laboratory glass wares i.e. volumetric flask, beaker, burette and calibration constant. 2. Demonstrate the good laboratory practices like effect of dilution, temperature, taking observation, personal and apparatus safety. 3. Determine the presence of magnesium ion in heavy water by EDTA method and prepare calibration curve. 4. Evaluate the absolute and method errors in a set of data collected during determination of nitrogen in an organic compound. 5. Calculate the standard deviation and predict precision of analytical results. 6. Compare the inter laboratory error of a spectroscopic results. 7. Demonstrate the control of interference by masking by complexation. 8. Report the ten analytic results in significant numbers along with standard deviation. 9. Estimate the comparative effectiveness of different types of graphs like line, pi chart and bar graph. 10. Demonstrate the working of lab on chip like glucose sensor.	30

Suggested Evaluation Methods

Internal Assesment:20+10*	End Term Examination:
Theory • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid-Term Exam: 10 **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA	50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Dey, R. A. and Underwood, A. L., Quantitative Analysis, 6th Edition, Pearson.
2. Skoog, D. A., West, D. M., Holler, F. J., Crouch, S. R., Fundamental analytical chemistry, Thomson Asia Ltd.
3. Encyclopaedia of analytical chemistry: Applications, Theory, and Instrumentation, R A Meyor (Eds) Wiley and Sons (2000).

*Applicable for courses having practical component.

MCC-11

Session: 2025-26

Part A- Introduction

Subject	Chemistry
Semester	VI
Name of Course	**Physical Chemistry-III**
Course Code	B-23-CHE-602
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	MCC
Level of Course (As per Annexure-I)	100-199
Pre-requisite for the course (if any)	4.0
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Explain the working of electrochemical cells and different types of galvanic cell. 2. Devise a spontaneous galvanic cell using various combinations of half-cells. 3. Understand the concept of concentration cell 4. Use the appropriate galvanic cell to measure pH, calculate thermodynamic parametersand perform potentiometric titrations. 5. Understand different types of catalysts and mechanism of enzyme catalysis. 6. Perform potentiometric titrations using appropriate electrodes for quantitative analysis. 7. Explain rate law and derive rate equations for simple and complex reactions andunderstanding of theories of reaction rates. --- 8*. Hand on practice in preparation of organic/ inorganic compound, and determination of strength of various types of solutions using various instruments.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Electrochemical Cells:** Rules of oxidation/reduction of ions based on half-cell potentials, Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes.	12
II	**Chemical Kinetics** Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods for determination of rate laws. Kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.	11
III	**Temperature dependence of reaction rates;** Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates, introduction to electrode kinetics (qualitative aspects only). Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). Structure of electric double layer (qualitative aspects only).	11

IV	**Catalysis:** Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis- Menten mechanism, acid-base catalysis.	11
V*	(A) Potentiometry titrations: 1. Strong acid vs. strong base 2. Weak acid vs. strong base 3. Dibasic acid vs. strong base 4. Mixture of strong and weak acid vs strong base 5. Potassium dichromate vs. Mohr's salt (B) Study of Chemical Kinetics: 1. Iodide-persulphate reaction by Initial rate method 2. Acid hydrolysis of methyl acetate with hydrochloric acid. 3. Saponification of ethyl acetate by conductometric measurements.	30

Suggested Evaluation Methods

Internal Assesment: **20+10* Theory** • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid-Term Exam: 10 **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA	**End Term Examination:** **50+20***

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition,Oxford University Press.
2. Ball, D. W. (2017), Physical Chemistry, 2nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
4. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th Edition, McGrawHill Education.
5. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 5, 3rd Edition, McGrawHill Education.
6. Laidler K.J. (2003), Chemical Kinetics, 3rd Edition, Pearson Education India.
7. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R.Chand & Co, New Delhi.
8. Kapoor, K.L. (2019), A Textbook of Physical Chemistry, Vol.7, 1st Edition, McGrawHill Education.
9. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), Experiments in PhysicalChemistry, 8th Edition, McGraw-Hill, New York

*Applicable for courses having practical component.

MCC-12

Session: 2025-26			
Part A - Introduction			
Subject	Chemistry		
Semester	VI		
Name of the Course	**General Chemistry-III**		
Course Code	B-23-CHE-603		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure- I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the twelve principles of green chemistry and also build the basic understanding of toxicity, hazard and risk related to chemical substances. 2. Learn to calculate atom economy, E-factor and relate them in all organic synthesis 3. Appreciate the use of catalyst over stoichiometric reagents 4. Learn to use green solvents, renewable feedstock and renewable energy sources for carrying out safer chemistry 5. Appreciate the use of green chemistry in problem solving skills and critical thinking to innovate and find solutions to environmental problems. 6. Learn to design safer processes, chemicals and products through understanding of inherently safer design (ISD) 7. Appreciate the success stories and real-world cases as motivation for them to practice green chemistry 8*. Hand on practice to synthesize various compounds and determination of their melting points.		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03 + 03* Hours		

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Introduction:** Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry. ➢ Need of green chemistry ➢ Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each). • A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards).	12

II	**Principles of Green Chemistry**: The twelve principles of the Green Chemistry with their explanation, Special emphasis on the following: ➢ Prevention of waste / byproducts, pollution prevention hierarchy. ➢ Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy. ➢ Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources. ➢ Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. ➢ Green energy and sustainability. ➢ Real-time analysis for pollution prevention. ➢ Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation	11
III	**Real-world Cases in green chemistry:** Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.	11

IV	**Application of Green Chemistry Principles:** Concept familiarization and application of green chemistry principles using specific examples 1. Prevention of waste/ by products; waste or pollution prevention hierarchy 2. Green metrics to assess greenness of a reaction: Calculation of atom economy of the rearrangement, addition, substitution, and elimination reactions; calculation of E-factor for industrial processes 3. Prevention/ minimization of hazardous/ toxic products 4. Biomass derived Solvents: Physicochemical properties, Use of glycerol and its derivatives (Mizoroki–Heck reaction) and 2- methyltetrahydrofuran (Suzuki–Miyaura reaction). 5. Visible light induced Reactions: with examples such as, syntheses of caprolactam and vitamin D3, cis-trans isomerization of alkenes 6. Use of renewable starting materials: Illustrate with few examples such as biodiesel, bioethanol, polymers from renewable resources (PLA from corn), Synthesis and properties of 2- Methyltetrahydrofuran, furfural and 5-Aminolevulinic acid (DALA) from levulinic acid.	11
V*	Characterization by melting point, UV-Visible spectroscopy, IR spectroscopy and any other specific method should be done (Do any five; wherever applicable). 1. Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts. 2. Preparation of biodiesel from waste cooking oil and characterization (TLC, pH, solubility, combustion test, density, viscosity, gel formation at low temperature and IR can be provided). 3. Benzoin condensation using thiamine hydrochloride as a catalyst instead of cyanide. 4. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice. 5. Mechanochemical solvent free, solid-solid synthesis of azomethine using *p*-toluidine and *o*-vanillin/*p*-vanillin. 6. 6 Microwave-assisted Knoevenagel reaction using anisaldehyde, ethylcyanoacetate and ammonium formate. 7. Photoreduction of benzophenone to benzopinacol in the presence of sunlight. 8. Photochemical conversion of dimethyl maleate to dimethyl fumarate (*cis-trans* isomerisation)	30
Suggested Evaluation Methods		

Internal Assessment: 20+10* **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination: 50+20***

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
2. Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Edition, RSC Publishing.
3. Cann, M. C., Connely, M.E. (2000), Real-World cases in Green Chemistry, American Chemical Society, Washington.
4. Matlack, A.S. (2010), Introduction to Green Chemistry, 2nd Edition, Boca Raton: CRC Press/Taylor & Francis Group publisher.
5. Alhuwalia, V.K., Kidwai, M.R. (2005), New Trends in Green chemistry, Anamalaya Publishers.
6. Sidhwani, I.T, Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
7. Kirchoff, M.; Ryan, M.A. (2002), Greener approaches to undergraduate chemistry experiment, American Chemical Society, Washington DC.
8. Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K. (2013), Green Chemistry Experiments: A monograph, I.K. International Publishing House Pvt Ltd. New Delhi.
9. Pavia, D.L.; Lamponam, G.H.; Kriz, G.S.W. B. (2012), Introduction to organic Laboratory Technique- A Microscale approach, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
10. Sidhwani I.T. (2015), Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. DU Journal of Undergraduate Research and Innovation, 1(1),131-151. ISSN: 2395-2334.
11. Sidhwani, I.T; Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
12. Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, Department of Science and Technology, Government of India.

*Applicable for courses having practical component.

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DSE-4

Session 2025-26

Part A- Introduction

Subject	Chemistry		
Semester	VI		
Name of Course	**Elective Chemistry-VIII (Physical Chemistry)**		
Course Code	B-23-CHE-604 (E8)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Explain low and high quantum yield 2. Explain photosensitized reactions 3. Give details of various types of spectra and know about their application in structure elucidation 4. Apply the concept of quantization to spectroscopy. 5*. Hand on practice in preparation and estimation of some metal complexes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed. 97

Unit	Topics	Contact Hours
I	**Introduction to Molecular Spectroscopy and Photochemistry:** Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation. Characteristics of electromagnetic radiation. Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.	11
II	**Rotational, Vibrational , Raman and Electronic Spectroscopy: Rotational spectroscopy:** Selection rules, intensities of spectral lines, determination of bond lengths of diatomic molecules, isotopic substitution, classification of molecules based on moment of inertia, applications of rotation spectroscopy (e.g. microwave appliances) Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.	11
III	**Vibration-rotation spectroscopy:** diatomic vibrating rotator, P, Q, R branches. Raman spectroscopy: Qualitative treatment of Rotational Raman effect; effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Electronic spectroscopy Franck-Condon principle, electronic transitions, singlet and triplet states, Jablonski diagrams, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.	11
IV	**NMR and ESR:** Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low-resolution spectra, different scales (δ and T), spin-spin coupling and high resolution spectra, interpretation of PMR spectra of simple organic molecules like methanol, ethanol and acetaldehyde. Principles of ESR spectroscopy, hyperfine structures, ESR of simple radicals	12

V*	(A) Colorimetry : 1.Verify Lambert-Beer's law and determine the concentration of (i) $CuSO_4$ (ii) $KMnO_4$ (iii)$K_2Cr_2O_7$ in a solution of unknown concentration 2.Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture. 3.Study the kinetics of iodination of propanone in acidic medium. 4.Determine the amount of iron present in a sample using 1,10-phenathroline. 5.Determine the dissociation constant of an indicator (phenolphthalein). 6.Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide. (B) UV/Visible spectroscopy: 1.Study the 200-500 nm absorbance spectra of KMnO4 and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4)and determine the λmax values. Calculate the energies of the two transitions in differentunits (J molecule-1, kJ mol-1, cm-1, eV). 2.Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$. 3.Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde,2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectraof organic compounds. (C) Analysis of the given vibration-rotation spectrum of HCl(g)	30

Suggested Evaluation Methods

Internal Assessment: **20+10* Theory** • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid Term Exam: 10 **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA	**End Term Examination:** **50+20***

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Banwell, C.N.; McCash, E.M. (2006), Fundamentals of Molecular Spectroscopy, Tata McGraw- Hill.
2. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education.
3. Kakkar, R. (2015), Atomic & Molecular Spectroscopy, Cambridge University Press.
4. Engel, T.; Reid, P. (2013), Quantum Chemistry and Spectroscopy, Pearson.
5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R.Chand & Co, New Delhi.
6. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), Experiments in PhysicalChemistry, 8th Edition, McGraw-Hill, New York.
7. Kapoor, K.L. (2019), A Textbook of Physical Chemistry, Vol.7, 1st Edition, McGraw Hill Education.

*Applicable for courses having practical component.

DSE-4

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VI		
Name of Course	**Elective Chemistry-IX (Organic Chemistry)**		
Course Code	B-23-CHE-604 (E9)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Build a strong understanding of chemistry of food: composition of food, role of each component. 2. Understand some of the reactions and changes in individual food components which occur during processing, handling and storage 3*. Hand on practice in preparation and estimation of some metal complexes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**Carbohydrates:** Introduction, sources, functions, classification: monosaccharide, oligosaccharide and polysaccharide, structure and importance of polysaccharides in food chemistry (pectin, cellulose, starch, gums), chemical reactions of sugar: mutarotation, caramelisation; non enzymic browning and its prevention, role of carbohydrates as sweeteners in food.	11
II	**Lipids:** Introduction, sources, classification (fatty acids, phospholipids, fats & oils, waxes), common fatty acids present in oils and fats, Omega- 3&6 fatty acids, trans fats, chemical properties-Reichert Meissel value, Polenski value, iodine value, peroxide value, saponification value, effect of frying on fats, changes in fats and oils- rancidity, lipolysis, flavor reversion, auto-oxidation and its prevention.	11
III	Proteins Introduction, sources, classification (simple, conjugated, derived), structure of protein (primary, secondary and tertiary), physico-chemical & functional properties of proteins, protein denaturation.	11
IV	**Vitamin:** Introduction, classification: fat-soluble vitamins & water-soluble vitamins. **Minerals:** Introduction, classification: macrominerals (Ca, P, Mg) & microminerals (Se, Fe, I, Co, Zn, Cu, Se, Cr). Physiological importance of vitamins and minerals, effect of food processing on vitamins and minerals.	12
V*	1. Determination of moisture in food products by hot air oven-drying method. 2. Colorimetric determination of Iron in vitamin / dietary tablets. 3. 2, 6-Dichlorophenol indophenol method for estimation of vitamin C in a given solution/ lemon Juice/chillies. 4. Estimation of total soluble sugar content by ferricyanide method (volumetric analysis). 5. Determination of saponification value of the given fat/oil. 6. Determination of iodine value of the given fat/oil. 7. Qualitative tests for proteins and carbohydrates. 8. Qualitative estimation of cholesterol by Liebermann Burchard method.	30
	Suggested Evaluation Methods	

Internal Assessment:	End Term Examination:
20+10* Theory • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid Term Exam: 10 **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA	**50+20***

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. deMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), Principles of Food Chemistry, 4th Edition, Springer.
2. Msagati, T.A.M. (2013), Chemistry of Food Additives and Preservatives, Wiley-Blackwell.
3. Fennema, O.R. (2017), Food Chemistry, 5th Edition, CRC Press.
4. Attokaran, M. (2017), Natural Food Flavors and Colorants, 2nd Ed., Wiley-Blackwell.
5. Potter, N.N., Hotchkiss, J.H, (1995) Food Science, 5th Ed., Chapman & Hall.
6. Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H. (2002), Food Additives, 2nd Edition, CRC Press.
7. Coultate, T. (2016), Food: The Chemistry of its Components, 6th Edn., Royal Society of Chemistry.
8. Belitz, H. D.; Grosch, W. (2009), Food Chemistry, Springer.
9. Course: FOOD CHEMISTRY (iasri.res.in)
10. Ranganna, S. (2017). Handbook of analysis and quality control for fruits and vegetable products, 2nd Edn., McGraw Hill Education
11. Sawhney, S.K., Singh, R. (2001), Introductory Practical Biochemistry, Narosa Publishing House

*Applicable for courses having practical component.

DSE-5

Session 2025-26

Part A- Introduction

Subject	Chemistry		
Semester	VI		
Name of Course	**Elective Chemistry-X (Inorganic Chemistry)**		
Course Code	B-23-CHE-605 (E10)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Learn about radioisotopes, radioactive decay 2. Use of radiochemistry in various fields 3. Effect of radiations on health 4. Learn about nuclear energy and nuclear pollution 5* Hand on practice in study of Adsorption phenomenon and various kinetic parameters.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		

Part B- Contents of the Course

Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

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Unit	Topics	Contact Hours
I	**Introduction Atoms, composition of nucleus, mass number, isotopes, nuclear stability, radioactive decay, radioactivity in nature:** Natural and artificial radioisotopes, elementary particles, radioactive decay (α, β and γ decay), half-life period, types of nuclear reactions: nuclear fission and nuclear fusion.	11
II	**Nuclear power generation:** Nuclear Power generation from uranium ore (energy production and nuclear waste), introduction to nuclear reactors for energy and nuclear weapons. **Environment radioactivity:** Natural radioactivity, natural process that release radioactive material in environment, man-made events like Chernobyl disaster, bomb test, use of radiotracers in environmental studies.	11
III	**Applications of radiochemistry:** C 14 decay and radioactive dating, irradiation of food, radiotracers for studying chemical reactions (photosynthesis, metabolic studies of drugs, metabolism of organisms, fundamental properties of genetic material), medicinal application of radio chemicals in radiotherapy (use in cancer, hyperthyroidism, blood disorders), radio- pharmaceuticals, diagnostic procedures: CT, PET	11
IV	**Nuclear pollution and safety management:** Radiation protection standards, basics of radiation hazards, international guidelines on radiation protection, disposal of nuclear waste, nuclear disaster and it's managements, Effect of radiation on health: Biological effects of radiation, radiation monitors, dose limits for workers and public.	12
V*	1. Study the background radiation in different places and identify the probable source. (Data to be provided). 2. Survey the diagnostic procedures involving radio-chemistry in different diagnostic laboratories. 3. Write a report on the radio isotopes used in various diagnostic procedures 4. Write a report on safety measures taken in diagnostic labs. 5. Write a report on any two nuclear and radiation accidents focusing on their impact on human life, environment and economy.	30

Suggested Evaluation Methods

Internal Assessment:	End Term Examination:
20+10* Theory • Class Participation: 5 • Seminar/Presentation/Assignment/Quiz/Class Test etc: 5 • Mid Term Exam: 10 Practicum • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc: 10 • Mid-Term Exam: NA	50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Nuclear and radiochemistry, Konya J., Nagy N. 2nd Edition, Elsevier
2. Radiochemistry and Nuclear Chemistry, 4th Edition, Choppin G., Lilijenzin J-O, Rydberg J., Ekberg C. Elsevier.

*Applicable for courses having practical component.

DSE-5

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VI		
Name of Course	**Elective Chemistry-XI (General Chemistry)**		
Course Code	B-23-CHE-605 (E11)		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/ DSE/PC/AEC/VAC)	DSE		
Level of Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the role of different medicines on human physiology. 2. Gain the knowledge of active pharmaceutical ingredient and their roles in different disease. 3. Learn the proper use of different medicines and their effect and side effects. 4. Learn the techniques of administering blood group, pulse rate, blood pressure and may other general diagnostic applications. --- 5* Hand on practice in study of Adsorption phenomenon and various kinetic parameters.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Time: 03+03*		
Part B- Contents of the Course			

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Instructions for Paper-Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.

Unit	Topics	Contact Hours
I	**General Introduction:** Introduction-Health, disease, drugs, chemotherapy, approaches in drug designing, classification of drugs and their origin, Host guest interactions.	11
II	**Different class of medicines-I:** Structure of active ingredients, uses, dosage, side effects and their natural remedies: Analgesics and antipyretics- Aspirin, paracetamol, ibuprofen, morphine, codeine Antibiotics- Amoxicillin, norfloxacin, ciprofloxacin Antihistamines or antiallergics- Cetrizine and Levocetrizine (role of stereoisomers) Antiparasitic- Albendazole Antidiabetics- Insulin, Glipizide and metformin Antihypertensive – Amlodipine and its natural remedies- Rauwolfia.	11
III	**Different class of medicines-II:** Diuretic- Lasix Antidepressant-Zoloft and its natural treatment Antifungal – fluconazole, Itraconazole Antacids- Ideal properties of antacids, combinations of antacids, Sodium 40 Bicarbonate, ranitidine, milk of magnesia, aluminium hydroxide gel Anticoagulants/antiplatelet drugs- Warfarin, heparin and Ecosprin Anaesthetics- Atracurium, Desflurane Poison and Antidote: Sodium thiosulphate, Activated charcoal, Sodium nitrite. **Astringents:** Zinc Sulphate, Potash Alum Supplements- zinc and calcium, vitamins Synthesis of small molecule drugs like aspirin and paracetamol	11

IV	**Metals in drugs:** Li_2CO_3 (Camcolit) for manic-depressive illness, $NaHCO_3$ (Alka-seltzer) for heartburn, $Al(OH)_3$ (Gaviscon) for heartburn, As (melarsoprol) for sleeping sickness, Bi subsalicylate (pepto-Bismol) for heartburn and diarrhea, Bi subcitrate (De-nol) peptic ulcer, Zinc oxide with Fe_2O_3 (Calamine lotion) as antimicrobial agent. **Metals in Multivitamins:** Cyanocobalamin (Co), Ferrous fumerate (Fe), Magnesium oxide (Mg), Zinc Sulfate (Zn), Manganese sesulphate (Mn), Copper Sulfate (Cu), Sodium selenite (Se) and Chromium trichloride (Cr).	12
V*	1. Determination of heart rate and pulse rate, blood pressure and discussion on medicines affecting them. 2. Identification test- Magnesium hydroxide, Sodium bicarbonate, Calcium gluconate. 3. Preparation of inorganic pharmaceuticals- Boric acid Potash alum 4. Determination of sugar content in the given solution. 5. Estimation of zinc and calcium in a given solution. 6. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose). 7. Qualitative tests for Proteins 8. Qualitative analysis of vitamin C. 9. Isolation of paracetamol (API) from a commercial tablet 10. Isolation of aspirin (API) from tablet and recording of melting point (synthesis needs discussion)	30

Suggested Evaluation Methods

Internal Assessment:

20+10* Theory

- Class Participation: 5
- Seminar/Presentation/Assignment/Quiz/Class Test etc: 5
- Mid Term Exam: 10

Practicum

- Class Participation: NA
- Seminar/Demonstration/Viva-voce/Lab records etc: 10
- Mid-Term Exam: NA

End Term Examination: 50+20*

Part C- Learning Resources

Recommended Books/e-resources/LMS:

Theory:

1. Patrick, G. L. (2001) Introduction to Medicinal Chemistry, Oxford University Press.
2. Lemke, T. L. & William, D. A. (2002), Foye's Principles of Medicinal Chemistry, 5th Ed., USA,
3. Singh H.; Kapoor V.K. (1996), Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan.
4. Chatwal, G.R. (2010), Pharmaceutical chemistry, inorganic (vol. 1), Himalayan publishing house https://go.drugbank.com./
5. Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
6. Ahluwalia, V.K., Dhingra, S. (2004), Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.
7. Munwar, S., Ammaji, S.(2019), Comprehensive Practical Manual of Pharmaceutical Chemistry, Educreation Publishing.
8. Mondal, P., Mondal, S.(2019), Handbook of Practical Pharmaceutical Organic, Inorganic and Medicinal chemistry, Educreation Publishing.

*Applicable for courses having practical component.