KURUKSHETRA UNIVERSITY

KURUKSHETRA

(Established by the state legislature Act XII of 1964)
(A^{++} Grade NAAC Accredited)

Scheme of Examinations forUnder-Graduate Programme

Subject: Chemistry

Semester: V - VIII

[Minor change in the Scheme of VII Semester (Honours/Honours with Research in Chemistry) DSE-H1 instead of DSE-6]

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2024-25 (in phased manner)

KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF EXAMINATIONS FOR UNDER-GRADUATE PROGRAMME SUBJECT : CHEMISTRY 5TH TO 8TH SEMESTER W.E.F. THE SESSION 2024-2025 IN PHASED MANNER

THIRD YEAR: SEMESTER-5									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A, B & C	**CC-5 MCC-9 4 credit**	B-23 CHE-501	Chemistry-V	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**MCC-10 4 credit**	B-23 CHE-502	Inorganic Chemistry-II	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**DSE-2 4 credit Select one Option**	**Elective Chemistry(Select One option)**							
		B-23 CHE-503	Elective Chemistry-IV	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-504	Elective Chemistry-V	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-505	Elective Chemistry-VI	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		Elective Chemistry (Select One option)							
Scheme B & C	**DSE-3 4 credit**	B-23 CHE-506	Elective Chemistry-VII	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**

	Select one Option	B-23 CHE-507	Elective Chemistry-VIII	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-508	Elective Chemistry-IX	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme A, B & C	**Internship 4 credits**	**Internship#4 credit after 4th semester**							
THIRD YEAR: SEMESTER-6									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A, B & C	**CC-6 MCC-11 4 credit**	B-23 CHE-601	Chemistry-VI	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**MCC-12 4 credit**	B-23 CHE-602	Organic Chemistry-II	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**DSE-4 4 credit Select one Option**	**Elective Chemistry(Select One option)**							
		B-23 CHE-603	Elective Chemistry-X	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-604	Elective Chemistry-XI	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-	Elective	**3**	**3**	**20**	**50**	**70**	**3 hrs.**

		605	Chemistry-XII						
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**DSE-5 4 credit Select one Option**	**Elective Chemistry (Select One option)**							
		B-23 CHE-606	Elective Chemistry-XIII	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-607	Elective Chemistry-XIV	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-608	Elective Chemistry-XV	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme A only	**CC-6 4 credits**	**(Only for minor subject as chemistry) From Available CC-6/MCC-11 of 4 credits as per NEP**							

FOURTH YEAR: SEMESTER-7 (FOR HONOURS/HONOURS WITH RESEARCH IN Chemistry)

Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
for Honours in Chemistry/Honours with Research in Chemistry (For Scheme B & C)	**CC-H1 4 credit**	B-23 CHE-701	Physical Chemistry-III	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	CC-H2 4 credit	B-23 CHE-702	Inorganic Chemistry-III	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	CC-H3 4 credit	B-23 CHE-703	Organic Chemistry-III	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	Select any one option								

	DSE-H1 **4 credit** **Select one Option**	B-23 CHE -704	Advanced Chemistry-I	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
		B-23 CHE -705	Advanced Chemistry-II	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
		B-23 CHE -706	Advanced Chemistry-III	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	PC-H1 **4 credit**	B-23 CHE -707	Practical Chemistry	**4**	**8**	**30**	**70**	**100**	**6 hrs.**
	CC-HM1 **4 credit**	B-23 CHE -708	**Advanced Minor Chemistry – I**	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
SEMESTER-8 (FOR HONOURS in Chemistry)									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Honours in Chemistry **(For Scheme B & C)**	**CC-H4** **4 credit**	B-23 CHE -801	Physical Chemistry-IV	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	CC-H5 **4 credit**	B-23 CHE -802	Inorganic Chemistry-IV	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	CC-H6 **4 credit**	B-23 CHE -803	Organic Chemistry-IV	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	DSE-H2 **4 credit** **Select one option**	**Elective (Select any one)**							
		B-23 CHE -804	Advanced Chemistry-IV	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
		B-23 CHE -805	Advanced Chemistry-V	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
		B-23 CHE -806	Advanced Chemistry-VI	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	PC-H2 **4 credit**	B-23 CHE	Practical	**4**	**8**	**30**	**70**	**100**	**6 hrs.**

		-807	Chemistry						
	CC-HM2 **4 credit**	B-83 CHE -808	**Advanced Minor Chemistry - II**	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
OR SEMESTER-8 (FOR HONOURS WITH RESEARCH IN Chemistry)									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Honours with Research in Chemistry **(For Scheme B & C)**	**CC-H4** **4 credit**	B-23 CHE -801	Physical Chemistry-IV	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	CC-H5 **4 credit**	B-23 CHE -802	Inorganic Chemistry-IV	**4**	**4**	**30**	**70**	**100**	**3 hrs.**
	Project/Dissertation **12 credit**	B-23 CHE -809	Dissertation/project in chemistry	**8+4**	**-**	**-**	**-**	**300**	**-**
	CC-HM2 **4 credit**	**From Available Minor of 4 credits as per NEP**							

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Syllabus for Under-Graduate Programme

Subject: Chemistry

Semester: V - VIII

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2024-25 (in phased manner)

CC-5/ MCC-9

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<tr><td colspan="4">Session 2024-25</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">V</td></tr>
<tr><td>Name of Course</td><td colspan="3">Chemistry-V</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-501</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">CC/MCC</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Enable to understand the basis of coordination chemistry of complexes.
2. To learn about role of thermodynamics and equilibrium in predicting various physical properties of systems.
3. Get knowledge about the quantum mechanical properties and analysis of diatomic molecules by spectroscopy.
4. To understand the synthesis and mechanism of some organic reactions and heterocyclic compounds.
_____
5*. Hand on practice in preparation of metal complexes, identification of organic and measurement of surface tension of solutions.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Examination Time: 03+03* Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
</table>

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	**Coordination Compounds:** Werner's theory of coordination compounds, EAN, chelates, nomenclature of coordination compounds, isomerism in coordination compounds. **Metal Ligand Bonding in Transition Metal Complexes:** Valence bond theory, applications and their Limitation, Elementary idea of CFT (Only structural aspects), Crystal field splitting in octahedral, tetrahedral and square planer complexes. **Magnetic properties of transition metal complexes:** Types of magnetic materials, magnetic susceptibility, method of determination, spin only formula, basic idea of L-S coupling.	11
II	**Thermodynamics-II:** Third Law of Thermodynamics, Nernst Heat Theorem, Statement of concept of residual entropy, evaluation absolute entropy from heat capacity data. Gibbs function and Helmholtz Function as thermodynamic quantities. Criteria for thermodynamic equilibrium and spontaneity. Variation of G with P, V and T, Partial molar properties, concept of chemical potential (numerical included) **Phase Equilibria:** Statement and the meaning of terms-phase component and degree of freedom, Thermodynamic derivation of Gibbs phase rule, Phase equilibria of one component system-water system, phase equilibria of two component systems solid-liquid equilibria, simple Eutectic Pb-Ag system.	11
III	**Quantum Mechanics-I:** Black body radiation, plank's radiation law, Explanation of spectral distribution of black body radiation on the basis of classical mechanics and quantum mechanics, Heat capacity of solids, Need of quantum mechanics, postulates of quantum mechanics, quantum mechanical operator, Commutation relations, Hamiltonian operator, Role of operators to derive Schrodinger wave equation, Application Schrodinger wave equation in determination of wave function and energy of a particle in one dimensional box **Spectroscopy-I:** Electromagnetic radiations, reasons of electromagnetic spectrum, basic features of spectroscopy, introduction to molecular spectroscopy and its difference from atomic spectroscopy, signal to noise ratio, resolving power of spectrophotometer, Born-Oppenheimer approximation, Concept of degree of freedom. **Rotational Spectrum:**Energy levels of rigid rotator of diatomic molecules, selection rules, spectral intensity distribution using Maxwell-Boltzmann distribution, Determination of bond length and	11

	concept of isotopic effect	
IV	**Organic Synthesis via Enolates** Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. **Heterocyclic Compounds** Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.	12
V*	1. Systematic identification (detection of extra elements, Functional Groups, determination of Melting Point and preparation of atleast one solid derivative) of the following simple mono-functional organic compounds: Naphthalene, p-dichlorobenzene, m-dinitrobenzene, α & β naphthol, Oxalic acid, succinic acid, benzoic acid, phthalic acid, Benzamide, urea, thiourea, glucose, fructose and sucrose. 2. Determine the solubility product of $Ca(OH)_2$ at room temperature by titrating it against 0.5 N HCl solution volumetrically. 3. Determine electrode potential of Zinc and Copper electrode in 0.1 M and 0.01M solution and calculate E^o value for these electrodes.	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. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.

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), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company
4. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
5. Peter, A.; Paula, J. de. (2011), Physical Chemistry, 9th Edition, Oxford University Press.
6. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
7. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 2, 6th Edition, McGraw Hill Education.
8. Kapoor, K.L., A Textbook of Physical Chemistry, Vol 3, 5th Edition, McGraw Hill Education
9. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
10. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books.
11. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill.
12. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier
13. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education).
14. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International
15. B.D. Khosla, V.C.Garg, A. Gulati, Senior Practical Physical Chemistry R. Chand & Company, New Delhi

*Applicable for courses having Practical component

CC-5/ MCC-10

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	**Inorganic Chemistry-II**		
Course Code	B-23-CHE-502		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of Course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the thermodynamic and kinetic aspects of metal complexes. 2. To learn about electronic spectra of transition metal complexes. 3. Get knowledge about the some advance studies in investigating electronic spectra of transition metal complexes 4. To know about the concept of organometallic complexes, their classification with reference to σ bonded organometallics _____ 5*. Hand on practice in preparation of solutions, compounds, estimation and determination of physical properties of some compounds.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
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	**Thermodynamic and Kinetic aspects of Metal Complexes**: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, Erving William Series, Substitution reactions of Square planner complexes of Pt(II), Trans Effect and theories.	11
II	**Electronic spectra of transition metal complexes-I: C**alculation of microstates ,Rules for d-d transition, term symbols, spectroscopic ground states, spectrochemical series, Orgel energy level diagrams for d^1 to d^9 states	11
III	**Electronic spectra of transition metal complexes-II:** General theory of Tanabe-Sugano diagrams for transition metal complexes, Graphical presentation and explanation of T-S diagram for d1 to d9 states, Discussion of electronic spectrum $[Ti(H_2O)_6]^{3+}$	11
IV	**Organometallic Chemistry:** Definition, classification and nomenclature of organometallic compounds, preparation, properties, and bonding of alkyls of Li and Hg, concept of hapticity of organic ligand, Structure and bonding in metal-ethylenic complexes $[PtCl_3(C_2H_4]$, Structure of Ferrocene, classification in metal carbonyls, properties and bonding in mononuclear carbonyls.	12
V*	1. Preparation: preparation of Mohr salt, prussian blue, Chrome alum, potash alum. 2. Gravimetric analysis: Estimation of copper as CuSCN and Al^{3+} as aluminiumoxinate.	

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. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic ChemistryPrinciples of

Structure and Reactivity, Pearson Education.
2. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company
3. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
4. Gupta, B. D., Elias, A. J., (2013) Basic Organometallic Chemistry: Concepts, Syntheses and Applications, 2nd Edition, Universities Press.
5. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. Basic Inorganic Chemistry, 3rd Edition, Wiley India

*Applicable for courses having Practical component

DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	**Elective Chemistry-IV**		
Course Code	B23-CHE-503		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the basis concept about carboxylic acid & their derivatives. 2. To learn about synthesis and chemical reactions of amines. 3. Get knowledge about the chemical reactions of ether, epoxides and diazonium salts. 4. To know about synthetic polymer & dyes and their uses. 5*. To learn about different functional groups, identification of compounds and their derivatives.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
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	**Carboxylic Acids** Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids.	12

	Mechanism of decarboxylation. **Carboxylic Acid Derivatives** Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).	
II	**Amines** Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabrielphthalimide reaction, Hofmann bromamide reaction. Electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.	11
III	**Ether & Epoxides** Preparation and reactions of ethers and epoxides with acids. Reactions of epoxides with alcohols, ammonia derivatives. Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides **Diazonium Salts** Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO_2 and CN groups, reduction of diazonium salts to hyrazines, coupling reaction and its synthetic application.	11
IV	**Synthetic Polymers** Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins. Natural and synthetic rubbers **Synthetic Dyes** Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes–Methyl orange; Triphenyl methane dyes-Malachite green, Phthalein Dyes – Phenolphthalein; Natural dyes –structure elucidation and synthesis of Alizarin; Edible Dyes with examples.	11
V*	1. Detection of extra elements. 2. Functional group test for nitro, amine and amide groups. 3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds) 4. Preparation of derivatives of given compounds. 5. Conformation of given compounds with the help of IR & NMR spectra.	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. Organic Chemistry Volume II & III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education).
4. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International.
5. Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2016), Organic Chemistry, 12th Ed., Wiley.
6. Flory, Paul J. Principles of polymer chemistry. (1953) Ithaca: Cornell University Press.

DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	**Elective Chemistry-V**		
Course Code	B23-CHE-504		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the function of enzymes and their classification. 2. To learn about energy biosystems. 3. Get knowledge about pharmaceutical compounds and their therapeutic uses. 4. To know about synthesis and chemical reactions of sulphur containing compound and polynuclear hydrocarbons. 5*. Hand on practice to synthesize various compounds and determination of their melting points.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
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	**Enzymes** Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions,	12

	specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).	
II	**Concept of Energy Biosystems** Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD+, FAD. Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein. Caloric value of food, standard caloric content of food types.	11
III	**Pharmaceutical Compounds** Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).	11
IV	**Sulphur Containing Compounds** Preparation and reactions of thiols, thioethers and sulphonic acids. **Polynuclear Hydrocarbons** Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.	11
V*	1. Detection of extra elements. 2. Functional group test for nitro, amine and amide groups. 3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds) 4. Preparation of derivatives of given compounds.	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. Organic Chemistry Volume I & II by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
3. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition.W.H. Freeman and Co.
4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition.Lange Medical Books/ McGraw-Hill

DSE-2

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	V		
Name of the Course	**Elective Chemistry-VI**		
Course Code	B23-CHE-505		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the basis concept about carboxylic acid & their derivatives. 2. To learn about synthesis and chemical reactions of amines. 3. Get knowledge about pharmaceutical compounds and their therapeutic uses. 4. To know about synthesis and chemical reactions of sulphur containing compound and polynuclear hydrocarbons. 5*. To learn about different functional groups, identification of compounds and their derivatives.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
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 is allowed.

Unit	**Topics**	**Contact Hours**

I	**Carboxylic Acids** Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. General methods of preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. **Carboxylic Acid Derivatives** Nomenclature and structure of Carboxylic acid derivatives, Physical properties, relative reactivities of acyl derivatives, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).	12
II	**Amines** Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabrielphthalimide reaction, Hofmann bromamide reaction). Electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.	11
III	**Pharmaceutical Compounds** Classification, structure and therapeutic uses of the followings: antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). Antibiotics: An elementary idea, Classification, Synthesis and uses of Penicillin-G, chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).	11
IV	**Suphur Containing Compounds** Preparation and reactions of thiols, thioethers and sulphonic acids. **PolynuclearBenzenoid Aromatic Hydrocarbons** Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.	11
V*	1. Detection of extra elements. 2. Functional group test for nitro, amine and amide groups. 3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds) 4. Preparation of derivatives of given compounds.	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**		**End Term Examination:**

• 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. Organic Chemistry Volume II by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education).
4. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International.
5. Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2016), Organic Chemistry, 12th Ed., Wiley.
6. Flory, Paul J. Principles of polymer chemistry.(1953) Ithaca:Cornell University Press.
7. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
8. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition.W.H. Freeman and Co.
9. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition.Lange Medical Books/ McGraw-Hill

DSE-3

<table>
<tr><td colspan="4">Session 2024-25</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">V</td></tr>
<tr><td>Name of Course</td><td colspan="3">Elective Chemistry-VII</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23 CHE-506</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-3</td></tr>
<tr><td>Level of Course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Enable to understand the basis of quantum mechanics.
2. To learn about concept of transition between vibrational energy levels of diatomic molecules and understand the Raman effect and Raman Spectroscopy.
3. Get knowledge of transition between various types of energy levels and NMR and ESR spectroscopic investigations of molecules.
4. To understand the principles and electronic spectra of simple molecules.
_____
5*. Hand on practice in the investigations of distribution of solute in different solvents, degree of hydrolysis of organic salts.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Examination Time: 03+03* Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
</table>

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	**Quantum Mechanics-II** Operators, Hermitian Operator and its properties, quantum mechanical derivation of Heisenberg's uncertainty Principal, derivation of time –dependent Schrodinger wave equation and its Application to calculate the wave function and energy of particle moving in three dimensional box, concept of Degree of Degeneracy.	11
II	**Vibrational Spectroscopy** Vibrational energy levels of simple Harmonic Oscillator, selection rules, Vibrational spectra of simple Harmonic Oscillator, Types of molecule showing vibrational spectra, Energy level of anharmonic oscillator, selection rules for the vibrational transitions in anharmonic oscillator, vibration rotational spectra of diatomic molecules. P, Q and R branches of vibration and rotational spectra, Intensities of lines in P and R branches, Results of the vibrational rotational spectrum. Elementary idea of vibrational transition of polyatomic molecules, Concept of isotopic effect by vibrational spectra. **Raman Spectroscopy** Introduction, Concept of Rayleigh and Raman line**s,** Raman Shift, Stokes' lines and Anti-stokes' lines, Concept of polarizability of molecule and Raman spectra, Types of molecules showing Raman Spectra, Explanation of Raman Effect in terms of polarizability, Quantum theory of pure rotational Raman spectra and spectral intensities of diatomic molecule and application. Rotational vibrational Raman Spectra of diatomic molecules. Advantage of Raman spectra over other spectroscopy. Experimental arrangement for Raman Spectra.	11
III	**Nuclear Magnetic Resonance (NMR) Spectroscopy** Principles of nuclear magnetic resonance, spin quantum number and angular momentum for the nucleus of (H, C, N, O and P), Concept of splitting of energy levels in a magnetic field, Concept of ESR spectra differ from NMR spectra for taking example of hydrogen, NMR technique/spectrometer, Interpretation of NMR spectra (Ethyl alchohal, Ethyl acetate, Acetone, Benzaldehyde), Chemical shift, shielding and deshielding of protons, nuclear spin-spin interaction, application of NMR spectra. **Electronic Spin Resonance Spectroscopy (ESR)** Concept of ESR spectra for unpaired electron, g factor, hyperfine	11

	structure in ESR spectra, selection rules, hyperfine splitting constant, predicting lines in ESR spectra for hydrogen atom, methyl radical with energy level diagram. Difference between NMR and ESR concept.	
IV	**Electronic Spectra** Features of Electronic spectroscopy, theory of electronic transition and band spectra, dissociation energy of molecule predicting from Electronic spectroscopy, Potential energy curves and Frank-Condon principle, electronic spectra of diatomic molecules, concept of parity, multiplicity of states, term symbol of diatomic molecules, selection rule, Molecular orbital energy level diagram of H_2, N_2, CO and O_2. Molecular orbitals involved in electronic transitions, concept of HOMO and LUMO and chromophores.	12
V*	1. To determine the distribution coefficient of following: I_2 between CCl_4/Chloroform and water, Benzoic acid between benzene and water, succinic acid between benzene and water, succinic acid between ether and water. 2. To determine the degree of Hydrolysis and hydrolysis constant of (i) CH_3COONa and (ii) NH_4Cl. 3. To study the inversion of cane sugar in presence of HCl and H_2SO_4, and hence determine the relative strength of the acids.	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. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Banwell, C.N.; McCash, E.M. (2006), Fundamentals of Molecular Spectroscopy, Tata McGraw- Hill.
3. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education.
4. Kakkar, R. (2015), Atomic & Molecular Spectroscopy, Cambridge University Press
5. Engel, T.; Reid, P. (2013), Quantum Chemistry and Spectroscopy, Pearson.

*Applicable for courses having Practical component

DSE-3

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	**Elective Chemistry-VIII**		
Course Code	B-23 CHE-507		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-3		
Level of Course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basics of quantum mechanical operators and investigate particle confined in three-dimentional box. 2. Able to solving Schrodinger Wave equation for Hydrogen like systems.. 3. Get the knowledge about Quantum mechanical formulation of VBT and MOT for diatomic molecule. 4. To understand the concept of adsorption and different adsorption isotherms _____ 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	3	2	5
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			
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	**Quantum Mechanics-II** Operators, Hermitian Operator and its properties, quantum mechanical derivation of Heisenberg's uncertainty Principal, derivation of time –dependent Schrodinger wave equation and its Application to calculate the wave function and energy of particle moving in three dimensional box, concept of Degree of Degeneracy.	11
II	**Quantum Mechanics-III (a)** Application of Quantum mechanics to hydrogen like particles, Schrodinger wave equation (SWE) in terms of polar coordinates, SWE for H-like particles, separation of variables, Expression for angular spherical wave function and radial wave function, Expression for energy of H like particles.	11
III	**Quantum Mechanics-III (b)** Quantum numbers, calculation of quantum numbers from SWE, concept of orbitals, shapes of orbitals, calculation of energy from wave functions, energy for hydrogen molecular ion (H_2^+) and H_2 molecule. Elementary idea of variation method to obtain the correct wave function, Valence Bond Theory, Application of VBT to study of hydrogen molecule, Basics of MOT, linear combination of atomic orbitals (LCAO)-H_2^+, Comparison of Bonding and Antibonding MO by graphical representation.	12
IV	**Surface Chemistry** Adsorption, types of adsorption, factors affecting adsorption, Mechanism of Adsorption, adsorption of gases by solids, adsorption isotherm, Freundlich, Langmuir and BET adsorption isotherm (including derivation). Specific surface area determination from Langmuir and BET adsorption isotherm.	11
V*	*To determine the distribution coefficient of following: I_2 between CCl_4/Chloroform and water, Benzoic acid between benzene and water, succinic acid between benzene and water, succinic acid between ether and water. *To determine the degree of Hydrolysis and hydrolysis constant of (i) CH_3COONa and (ii) NH_4Cl. *To study the inversion of cane sugar in presence of HCl and H_2SO_4, and hence determine the relative strength of the acids.	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.Quantum Chemistry,I.M.Levine,Prentice Hall

2.Quantum Chemistry,R.Prasad,New age international

3. Introduction to Quantum Chemistry,A.K.Chandra,Tata McGraw Hill

4.Physical Chemistry ,P.W. Atkins,Oxford university press

5. Molecular Quantum Mechanics,P.W. Atkins and R.S. Friedman,Oxford University Press

*Applicable for courses having Practical component

DSE-3

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	V		
Name of Course	**Elective Chemistry-IX**		
Course Code	B-23-CHE-508		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-3		
Level of Course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand quantum mechanical operators and solve Schrodinger wave equation for particle confined in three-dimentional box. 2. To understand the basics of vibrational spectroscopy of diatomic molecules. 3. To understand the concept and utility of Nuclear Magnetic Resonance (NMR) spectroscopy 4. To understand the concept ESR and Mossbauer spectroscopy. _____ 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	3	2	5
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 is allowed.

Unit	Topics	Contact Hours

I	**Quantum Mechanics-II** Operators, Hermitian Operator and its properties, quantum mechanical derivation of Heisenberg's uncertainty Principal, derivation of time –dependent Schrodinger wave equation and its application to calculate the wave function and energy of particle moving in three-dimensional box, concept of Degree of Degeneracy.	11
II	**Vibrational Spectroscopy:** Vibrational energy levels of simple Harmonic Oscillator, selection rules, Vibrational spectra of simple Harmonic Oscillator, Types of molecules showing vibrational spectra, Energy level of anharmonic oscillator, selection rules for the vibrational transitions in anharmonic oscillator, vibration rotational spectra of diatomic molecules. P, Q and R branches of vibration and rotational spectra, Intensities of lines in P and R branches, Results of the vibrational rotational spectrum. Elementary idea of vibrational transition of polyatomic molecules, Concept of isotopic effect by vibrational spectra.	11
III	**Nuclear Magnetic Resonance (NMR) Spectroscopy:** Principles of nuclear magnetic resonance, spin quantum number and angular momentum for the nucleus of (H, C, N, O and P), Concept of splitting of energy levels in a magnetic field, Concept of NMR spectra for hydrogen, NMR technique/spectrometer, Interpretation of NMR spectra (Ethyl alchohal, Ethyl acetate, Acetone, Benzaldehyde), Chemical shift, shielding and deshielding of protons, nuclear spin-spin interaction, application of NMR spectra.	12
IV	**Electronic Spin Resonance Spectroscopy (ESR)** Concept of ESR spectra for unpaired electron, g factor, hyperfine structure in ESR spectra, selection rules, hyperfine splitting constant, predicting lines in ESR spectra for hydrogen atom, methyl radical with energy level diagram. Difference between NMR and ESR concept. **Mossbauer Spectroscopy** Basic Principles of Mossbauer spectroscopy using example of iron nucleus, recoil energy, Doppler effect, Experimental arrangement of Mossbauer spectroscopy. Chemical shift.	11
V*	*To determine the distribution coefficient of following: I_2 between CCl_4/Chloroform and water, Benzoic acid between benzene and water, succinic acid between benzene and water, succinic acid between ether and water. *To determine the degree of Hydrolysis and hydrolysis constant of (i) CH_3COONa and (ii) NH_4Cl. *To study the inversion of cane sugar in presence of HCl	30

	and H_2SO_4, and hence determine the relative strength of the acids.	

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

Rec**ommended Books/e-resources/LMS:**

1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Quantum Chemistry,I.M.Levine,Prentice Hall
3.Quantum Chemistry, R.K. Prasad, New age International
4. Introduction to Quantum Chemistry,A.K.Chandra,Tata McGraw Hill
5.Physical Chemistry ,P.W. Atkins,Oxford university press
6. Molecular Quantum Mechanics, P.W. Atkins and R.S. Friedman,Oxford University Press
7. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education.
8.Kakkar, R. (2015), Atomic & Molecular Spectroscopy, Cambridge University Press.

*Applicable for courses having Practical component

CC-6/ MCC-11

<table>
<tr><td colspan="4">Session 2024-25</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of Course</td><td colspan="3">Chemistry-VI</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-601</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">CC/MCC
CC-6/MCC-11</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Enable to understand the chemistry of bioinorganic molecules.
2. To learn about fundamentals of photochemistry and photophysical processes.
3. To understand the concept of IR and NMR spectroscopy of organic compounds.
4. Enable to understand the synthesis and other properties of amino acids, carbohydrates and their derivatives.
_____
5*. Hand on practice in preparation of organic/ inorganic compound, and determination of strength of various types of solutions using various instruments.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Examination Time:03+03* Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
<u>Note</u>: The examiner is requested to set nine questions in all, selecting two questions from each</td></tr>
</table>

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	**Bioinorganic chemistry** Metal ions present in biological system, classification based on action (essential, non-essential, trace, toxic), Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of Na^{+}, K^{+}, Ca^{+2}, Mg^{+2}, Fe^{+2} ions, Cooperativity effect, Bohr effect.	12
II	**Photochemistry** Interaction of radiation with matter, difference between thermal and photochemical process, Law of photochemistry: Lambert-Beer Law, Grotthus-Drapper Law, Stark Einstein Law (Law of photochemical equivalence) , calculation of integrated absorption coefficient from electronic spectra, oscillator strength, concept of singlet and triplet states, Jablonski diagram – depicting various process occurring in excited states including fluorescence , phosphorescence and non-radiative processes (internal conversion, intersystem crossing). Calculation of lifetime of excited states. Quantum Yield, Photosensitized reaction- energy transfer process (Simple example).	11
III	**IR Spectroscopy** Infrared (IR) absorption spectroscopy Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. **NMR Spectroscopy** Principle of nuclear magnetic resonance, the PMR spectrum,number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift,shielding and deshielding of protons, proton counting,splitting of signals and coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide and 1,1-dibromoethane.	11
IV	**Amino Acids, Peptides** Amino acids, Peptides, and their classification. α-Amino Acids-Synthesis, ionic properties, and reactions. Zwitterions, pKa values, isoelectric point, and electrophoresis; Study of peptides: Synthesis of peptides using N-protecting, C-protecting, and C- activating groups. **Carbohydrates** Occurrence, classification, and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose	11

	and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projection and conformational structures; Interconversion of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation.	
V*	1. To determine the strength of given acid solution (mono acid only) conductometrically. 2. To determine the solubility and solubility product of sparingly soluble salt using conductometer. 3. To determine the strength of given Mohr's salt solution using potentiometer. 4. To determine the molecular weight of organic compound by Rast method. 5. To determine the specific rotation of an optically active substance by polarimeter. 6. To prepare a sample of p-bromoaniline from p-bromoacetanilide. 7. To prepare a sample of cuprous chloride. 8. To study the photochemical reaction of benzophenone and isopropyl alcohol.	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. Organic Chemistry Volume II & III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
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), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company
4. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
5. Pavia, D. (2015), Introduction to Spectroscopy, Fifth Edition, Cengage Learning India Pvt. Learning.
6. Ahluwalia, V.K., Parashar, R.K. (2011), Organic Reaction Mechanisms, 4th Edition, Narosa Publishing House.
7. Horspool, W.M. (1976) Aspects of Organic Photochemistry, Academic Press.
8. Singh J, Awasthi S K, Singh J, Fundamentals of Organic Chemistry, Pragati Prakashan

Meerut.
9. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th edition, McGraw Hill Education.
10. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 5, 6th Edition, McGraw Hill Education.
11. Kuashik, S., Singh, A. (2023), Biomolecules: From Genes to Proteins, First Edition, Berlin, Boston: De Gruyter.
12. DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), Principles of Food Chemistry, Fourth Edition, Springer.

*Applicable for courses having Practical component

MCC-12

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	VI		
Name of the Course	**Organic Chemistry-II**		
Course Code	B23-CHE-602		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-12		
Level of the course (As per Annexure-I)	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand about UV spectroscopy and analysis of UV spectra of organic compounds. 2. Get knowledge about NMR spectroscopy and to study NMR spectra of organic compounds. 3. To know about synthesis and chemical reactions of Organometallic compounds including Grignard reagents. 4. Get knowledge about synthesis and chemical reactions of heterocyclic compounds 5*. 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	**Ultraviolet (UV) absorption Spectroscopy** Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of	12

	conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and ⌊max of simple enones,Woodward-Fieser rules, calculation of-unsaturated ketones. ⟨, ®-conjugated dienes. Application of UV in structure determination.	
II	**NMR Spectroscopy** Introduction to PMR. Chemical Shift and factors affecting the Chemical Shift (Hydrogen bonding, inductive effect and Anisotropic effect) Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde, acetophenone, Nitrobenzene, Aniline, Phenol, benzoic acid, p-Toluic acid. Simple problems on PMR spectroscopy for structure determination of organic compounds.	11
III	**Organometallic Compounds** Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.	11
IV	**Heterocyclic Compounds** Introduction to condensed five and six-membered heterocycles compounds. Prepration and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of Indole, quinoline and isoquinoline.	11
V*	1. Preparation of 1,3,5-tribromobenzene from aniline. 2. Preparation of anthranilic acid from phthalic anhydride 3. Preparation of p-bromoaniline from acetanilide. 4. Preparation of triphenylmethyl bromide from triphenyl methane. 5. Preparation of benzoic acid from toluene/benzyl chloride. (Experiments should be carried out using minimum amount of chemicals)	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. Organic Chemistry Volume II by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.

2. Pavia, D. (2015), Introduction to Spectroscopy, Fifth Edition, Cengage Learning India Pvt. Learning.
3. Scheinmann, F., Introduction to spectroscopic methods for identification of organic compounds, Volume 2, Pergamon Press.
4. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic ChemistryPrinciples of Structure and Reactivity, Pearson Education.
5. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
6. Finar, I.L., (2012), Organic Chemistry Volume 1, 6th Edition, Pearson Education.
7. Singh J, Awasthi S K, Singh J, Fundamentals of Organic Chemistry, Pragati Prakashan Meerut.

DSE-4

<table>
<tr><th colspan="4">Session 2024-25</th></tr>
<tr><th colspan="4">Part A- Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of Course</td><td colspan="3">Elective Chemistry-X</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-603</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-4</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Get knowledge of theory and application of X-Ray and DLS techniques.
2. To understand the theory and application of UV, SEM & TEM techniques.Enable to understand the application of metals in bio-system.
3. Get knowledge about the quantitative analysis for unknown salts or its mixtures.
4 To learn about various separation techniques for different ions/compounds.
_____
5*. Hand on practice in preparation and estimation of some metal complexes.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Examination Time:03+03* Hours</td></tr>
<tr><th colspan="4">Part B- Contents of the Course</th></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
<u>Note</u>: 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</td></tr>
</table>

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	**Characterization techniques of inorganic solids-I:** Theories and applications of Powder X-ray Diffraction, Brunauer–Emmett–Teller (BET) surface area analyser, Dynamic Light Scattering (DLS)	11
II	**Characterization techniques of inorganic solids-II:** Theories and applications of UV-visible spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), IR and Fourier-Transform Infrared (FTIR) spectroscopy.	11
III	**Quantitative Analysis** Theory of quantitative analysis. Gravimetric analysis: Preparation, structure and geometry of Ni-Dimethyl glyoxime, role of ammonia in the preparation, calculation of expected yield. Preparation, structure and geometry of Cu-isothiocynate complex.	11
IV	**Separation techniques** Solvent extraction: Classification, principle and efficiency of the technique. Qualitative aspects of solvent extraction: extraction of metal ions from aqueous solution and non-aqueous media. Chromatography: Classification, principle and efficiency of the technique, ion-exchange method.	12
V*	1. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$. 2. Preparation of potassium aluminium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum), Potassium chromium sulphate $KCr(SO_4)_2.12H_2O$ (Chrome alum). 3. Paper Chromatographic separation of following metal ion Ni(II) and Co(II) Fe(III) and Al(III). 4. Synthesis and purification of $[Ni(diphenyamine)_4(NO_3)(H_2O)](NO_3)_2$ from $NiNO_3$. 5. Synthesis and purification of $[Ca(EDTA)]^{2-}$ complex. 6. Synthesis and purification of $[Mg(EDTA)]^{2-}$ complex.	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. 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. Rao, C. N. R.; Gopalakrishnan, J. (1997), New Direction in Solid State Chemistry, Cambridge University Press
4. Poole Jr.; Charles P.; Owens, Frank J. (2003), Introduction to Nanotechnology, John Wiley and Sons
5 Solvent Extraction: Separation of Elements with Liquid Ion Exchangers by S.M. Khopkar, 2nd Edition, New Age International.
6 Basics and Techniques of Quantitative Analysis by Anup Kumar Shrivastava, 1st Edition.
7 Characterization Methods in Inorganic Chemistry by Mark T. Weller and Nigel A. Young, Oxford

*Applicable for courses having Practical component

DSE-4

<table>
<tr><th colspan="4">Session 2024-25</th></tr>
<tr><th colspan="4">Part A- Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of Course</td><td colspan="3">Elective Chemistry-XI</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-604</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-4</td></tr>
<tr><td>Level of Course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Enable to understand the role of dioxygen carriers and also synthetic model compounds
2. To learn about basic concept of ion exchange chromatography and their utilization.
3. Get knowledge about the concept of optical rotatory disperson and circular dichroism.
4. To understand the various basics to synthesize the inorganic solids.
_____
5*. Hand on practice in preparation and estimation of some metal complexes.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Examination Time: 03+03* Hours</td></tr>
<tr><th colspan="4">Part B- Contents of the Course</th></tr>
<tr><td colspan="4"></td></tr>
<tr><th colspan="4"><u>Instructions for Paper-Setter</u></th></tr>
</table>

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	**Bioinorganic Chemistry :** Existance ofIron and its use in various bio-systems, Hemoglobin, Model compounds of dioxygen carrier, Myoglobin, cytochrome-C-oxidase ; Storage and transfer of iron,	11
II	**Ion-exchange chromatography:** basic concept of ion exchange chromatography, technique, intsrumentation, Column, ion-exchange chromatography. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).	11
III	**Circular Dichroism and Optical Rotatory Dispersion** Polarized light, fundamental symmetry requirements, for optical activity, interaction of polarized light with optically active matter, optical rotation, Cotton effect, configuration of Tris-chelated complexes.	11
IV	**Synthesis of inorganic solids:** Conventional heat and beat method, Co-precipitation method, Sol-gel method, Hydrothermal method, Chemical vapor deposition (CVD), Ion-exchange and Intercalation method.	12
V*	7. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$. 8. Preparation of potassium aluminium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum), Potassium chromium sulphate $KCr(SO_4)_2.12H_2O$ (Chrome alum). 9. Paper Chromatographic separation of following metal ion Ni(II) and Co(II) Fe(III) and Al(III). 10. Synthesis and purification of $[Ni(diphenyamine)_4(NO_3)(H_2O)](NO_3)_2$ from $NiNO_3$. 11. Synthesis and purification of $[Ca(EDTA)]^{2-}$ complex. 12. Synthesis and purification of $[Mg(EDTA)]^{2-}$ complex.	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

Rec**ommended Books/e-resources/LMS:**

1. Instrumental Methods of Analytical Chemistry by Willard, Merit and Dean, Settle.
2. Lippard, S.J.; Berg, J.M. (1994), Principles of Bioinorganic Chemistry, Panima Publishing Company.
3. Bioinorganic Chemistry- Inorganic Elements in the Chemistry of Life: An Introduction and Guide, 2nd Edition by Wolfgang Kaim, Brigitte Schwederski, Alex Klein.
4. Solvent Extraction: Separation of Elements with Liquid Ion Exchangers by S.M. Khopkar, 2nd Edition, New Age International.
5. Basics and Techniques of Quantitative Analysis by Anup Kumar Shrivastava, 1st Edition.
6. Rao, C. N. R.; Gopalakrishnan, J. (1997), New Direction in Solid State Chemistry, Cambridge University Press
7. 6. Poole Jr.; Charles P.; Owens, Frank J. (2003), Introduction to Nanotechnology, John Wiley and Sons

*Applicable for courses having Practical component

DSE-4

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	VI		
Name of Course	**Elective Chemistry-XII**		
Course Code	B-23-CHE-605		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-4		
Level of Course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Able to understand the composition of soil and their analysis 2. To know about the analysis of various food products 3. Have idea about analysis of cosmetics. 4. To know about basics of analytical chemistry. _____ 5*. Hand on practice in preparation and estimation of some metal complexes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
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 is allowed.

Unit	Topics	Contact Hours
I	**Analysis of Soil:** Composition of soil, concept of pH and pH measurement, complexometric titrations, chelation, chelating agents, use of indicators (only theoretical based): 1. Determination of pH of Samples. **2.** Estimation of calcium and magnesium ions as calcium carbonate by complexometric titrations.	11
II	**Analysis of food products:** Nutritional value of foods, idea about food processing and food preservatives and adulteration.	11
III	**Analysis of Cosmetics:** Major and minor chemical constituents and their function, analysis of deodorants and antiperspirants, Al, Zn, Boric acid, Chlorides and sulphate base. Determination of constituents of talcum powder, coriander powder and pulses.	11
IV	**Quantitative Analysis** Theory of quantitative analysis. Gravimetric analysis: Preparation, structure and geometry of Ni-Dimethyl glyoxime, role of ammonia in the preparation, calculation of expected yield. Preparation, structure and geometry of Cu-isothiocynate complex.	12
V*	*Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$. *Preparation of potassium aluminium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum), Potassium chromium sulphate $KCr(SO_4)_2.12H_2O$ (Chrome alum). *Paper Chromatographic separation of following metal ion Ni(II) and Co(II) Fe(III) and Al(III). *Synthesis and purification of $[Ni(diphenyamine)_4(NO_3)(H_2O)](NO_3)_2$ from $NiNO_3$. *Synthesis and purification of $[Ca(EDTA)]^{2-}$ complex. *Synthesis and purification of $[Mg(EDTA)]^{2-}$ complex.	30
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

Rec**ommended Books/e-resources/LMS:**

1. Basics and Techniques of Quantitative Analysis by Anup Kumar Shrivastava, 1st Edition.
2. Willard, H.L. Merritt, L.L., Dean, J. & Settle, F.A. Instrumental methods of analysis, 7th Ed. Wadsworth publishing Co. Ltd., Belmont, California, USA, 1988.
3. Chemistry 6th ed., Saunders College Publishing, fort Worth (1992).
4. Harris, D.C. quantitative Chemical Analysis, W. H. Freeman.
5. Dean, J.A. Analytical Chemical Notebook, McGraw Hill.

DSE-5

Session 2024-25			
Part A- Introduction			
Subject	Chemistry		
Semester	VI		
Name of Course	**Elective Chemistry-XIII**		
Course Code	B-23-CHE-606		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-5		
Level of Course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the basic concepts of nuclear chemistry and various processes occurs during the nuclear reactions. 2. Have knowledge about basic of catalysis and their relative aspects. 3. To get information about colloidal state. 4. To learn about macromolecules and obtain basic knowledge of liquid crystals. _____ 5*. Hand on practice in study of optical properties and various kinetic parameters.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
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	**Nuclear Chemistry** Radioactivity, rays from radioactive materials, Radioactive disintegration, Half-life period, Radioactive equilibrium. Steady State, Theory of Radioactivity, carbon dating, radioactive isotopes, radiochemical principle in the use of tracers, application of tracers in chemical investigation, physicochemical methods, age determination and agricultural applications.	11
II	**Catalysis** General characteristics of catalytic reactions, acid-base catalysis, enzyme catalysis, Michaelis-Menten equation, Effect of temperature on enzyme catalysis, heterogeneous catalysis, surface reactions, Kinetics of unimolecular surface reaction, pH-dependence of rate constants of catalyzed reactions. Autocatalysis.	11
III	**Colloidal State:** Colloids – Lyophilic and Lyophobic, properties of colloidal systems, Surfactants and its types, micelle formation, critical micelle concentration (CMC), factor affecting CMC, methods to determine CMC (electrical conductivity and surface tension), solubilization, emulsification - Emulsions, emulsifiers, factors determining stability of emulsions. Gels - Elastic and Non-elastic gels. Importance and applications of colloids.	11
IV	**Macromolecules** Polymers, Classification of polymers and examples, degree of polymerization, types of polymerization reactions with examples only, Molar mass of polymers: Number average method and weight average method and related numericals. Determination of molar mass of macromolecules by viscometry. **Liquid Crystals** Mesomorphic state, classification of liquid crystals and molecular arrangements in various states, applications of liquid crystals.	12
V*	1. Investigate the autocatalytic reaction between potassium permanganate and oxalic acid. 2. Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurements, and hence determine the energy of activation of the reaction. 3. Determine the order of hydrolysis of ethyl acetate by sodium hydroxide. 4. Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide. 5. Determine the molar refractivity of ethyl acetate and benzene by Abbe's refractometer.	30

	6. Determine the electron polarization and electron Polarizability of a liquid using Abbe's refractometer. 7. Determine the composition of an unknown mixture of two given liquids by refractive index measurements.	

Suggested Evaluation Methods

Internal Assesment:20+10*	**End Term Examination: 50+20***
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	

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Arnikar, H.J., (1987), Second Edition, Essentials of Nuclear Chemistry, Wiley Blackwell Publishers.
2. Arnikar, H.J.; Rajurkar, N. S.,(2016) Nuclear Chemistry through Problems, New Age International Pvt. Ltd.
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, 3rd Edition, McGraw Hill Education.
5. Laidler K.J. (2003), Chemical Kinetics, 3rd Edition, Pearson Education India
6. Campbell, Ian M., (2000), Introduction to Synthetic Polymers, Second Edition, Oxford University Press, USA. 4. Bahadur, P. and Sastry, N.V. (2002) Principles of Polymer Science Narosa, New Delhi.
7. Khopkar, S.M. (2008), Basic Concepts of Analytical Chemistry, New Age International Publisher.

*Applicable for courses having Practical component

DSE-5

<table>
<tr><th colspan="4">Session 2024-25</th></tr>
<tr><th colspan="4">Part A- Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of Course</td><td colspan="3">Elective Chemistry-XIV</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-607</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-5</td></tr>
<tr><td>Level of Course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. To know the basic concepts of classical and quantum statistics.
2. Students may enable to understand the calculation of thermodynamic properties from statistics.
3. To get information of partition function and leads to get physical properties of systems.
4. To learn about the concept and qualitative treatment of simple harmonic oscillator and Rigid rotator.
_____
5* Hand on practice in study of Adsorption phenomenon and various kinetic parameters.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Examination Time:03+03* Hours</td></tr>
<tr><th colspan="4">Part B- Contents of the Course</th></tr>
<tr><td colspan="4"></td></tr>
</table>

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	**Statistical Mechanics:** Concept of Classical statistics, Classical Statistical mechanics: Postulates, microcanonical, canonical, grand canonical ensembles; non-interacting examples. Statistical analysis of Maxwell-Boltzmann's distribution law. Quantum Statistical Mechanics: Concept of quantum statistics for distinguishable and in distinguishable molecules. Quantization effect in molecular gases, phonons, photons, degenerate quantum gases; Concept and statistical distribution of Fermions and Bosons.	11
II	**Statistical Thermodynamics-I**: Need for Statistical Thermodynamics, Significance of Boltzmann constant, thermodynamic probability, relationship between entropy and probability, partition function, expression for thermodynamic functions in terms of partition function, heat content, heat capacity at constant volume/constant pressure, entropy, Gibbs free energy and Helmholtz free energy, separation of partition function into translational, rotational, vibrational and electronic partition function.	11
III	**Statistical Thermodynamics- II:** Expression for translational, rotational and vibrational partition functions, Thermal de Broglie wavelength, characteristics rotational temperature, Relationship between internal energy and partition function, Thermodynamic functions, contribution of translational partition function to express translational energy; Sackur Tetrode equation, Contribution of rotational and vibrational partition function to express rotational/vibrational energy, heat content, heat capacity at constant volume/constant pressure, entropy, Helmholtz free energy and Gibbs free energy.	11
IV	**Rigid rotator:** Rigid rotator model for rotation of diatomic molecules, expression for energy levels, degree of degeneracy. **Harmonic oscillator:** Concept and qualitative treatment of simple harmonic oscillator model of vibrational motion, classical and quantum mechanical treatment for harmonic oscillation, results of harmonic oscillator. Expression for wave functions of harmonic oscillator (derivation included)	12

V*	8. Investigate the adsorption of oxalic acid from aqueous solutions by activated charcoal, and examine the validity of classical and Langmuir's adsorption isotherm. 9. Determine the adsorption isotherm of acetic acid from aqueous solution by charcoal. 10. Investigate the autocatalytic reaction between potassium permanganate and oxalic acid. 11. Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurements, and hence determine the energy of activation of the reaction. 12. Determine the order of hydrolysis of ethyl acetate by sodium hydroxide. 13. Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide. 14. Study the inversion of cane sugar in presence of HCl and H_2SO_4 acids, and hence determine the relative strength of the acids.	30

Suggested Evaluation Methods

Internal Assesment:20+10*	**End Term Examination: 50+20***
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	

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education.
2. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
3. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books.
4. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill.
5. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
6. Statistical Thermodynamics 2nd Edition M.C.Gupta.

*Applicable for courses having Practical component

DSE-5

<table>
<tr><td colspan="4">Session 2024-25</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of Course</td><td colspan="3">Elective Chemistry-XV</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-608</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-5</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. To know the basic concepts of nuclear chemistry and various processes occurs during the nuclear reactions.
2. Have knowledge about basic of catalysis and their relative aspects.
3. To get information of partition function and leads to get physical properties of systems.
4. To learn about the concept and qualitative treatment of simple harmonic oscillator and Rigid rotator.
_____
5* Hand on practice in study of Adsorption phenomenon and various kinetic parameters.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Max marks:70+30*
Internal Assessment Marks:20+10*
End Term Exam Marks:50+20*</td><td colspan="3">Time: 03+03*</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
</table>

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	**Nuclear Chemistry:** Radioactivity, rays from radioactive materials, Radioactive disintegration, Half-life period, Radioactive equilibrium. Steady State, Theory of Radioactivity, carbon dating, radioactive isotopes, radiochemical principle in the use of tracers, application of tracers in chemical investigation, physicochemical methods, age determination and agricultural applications.	11
II	**Catalysis** General characteristics of catalytic reactions, acid-base catalysis, enzyme catalysis, Michaelis-Menten equation, Effect of temperature on enzyme catalysis, heterogeneous catalysis, surface reactions, Kinetics of unimolecular surface reaction, pH-dependence of rate constants of catalyzed reactions. Autocatalysis.	11
III	**Statistical Thermodynamics-I:** Need for Statistical Thermodynamics, thermodynamic probability, relationship between entropy and probability, partition function, expression for thermodynamic functions in terms of partition function, heat content, heat capacity at constant volume and at constant pressure, entropy, Helmholtz free energy and Gibbs free energy, separation of partition function into translational, rotational, vibrational and electronic partition function. Expression for translational, rotational and vibrational partition functions.	11
IV	**Rigid rotator:** Rigid rotator model for rotation of diatomic molecules, expression for energy levels, degree of degeneracy. **Harmonic oscillator:** Concept and qualitative treatment of simple harmonic oscillator model of vibrational motion, classical and quantum mechanical treatment for harmonic oscillation, results of harmonic oscillator. Expression for wave functions of harmonic oscillator (derivation included)	12
V*	*Investigate the adsorption of oxalic acid from aqueous solutions by activated charcoal, and examine the validity of classical and Langmuir's adsorption isotherm. *Determine the adsorption isotherm of acetic acid from	30

	aqueous solution by charcoal. *Investigate the autocatalytic reaction between potassium permanganate and oxalic acid. *Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurements, and hence determine the energy of activation of the reaction. *Determine the order of hydrolysis of ethyl acetate by sodium hydroxide. *Determine the velocity constant of hydrolysis of ethyl acetate by sodium hydroxide. *Study the inversion of cane sugar in presence of HCl and H_2SO_4 acids, and hence determine the relative strength of the acids.	

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

Rec**ommended Books/e-resources/LMS:**

1. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, McGraw Hill Education, Vol 4, 5th Edition, McGraw Hill Education.
2. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
3. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books.
4. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill.
5. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier
6. Statistical thermodynamics 2nd Edition M.C.GUPTA
7. Arnikar, H.J.; Rajurkar, N. S.,(2016) Nuclear Chemistry through Problems, New Age International Pvt. Ltd.
8. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th Edition, McGraw Hill Education.

*Applicable for courses having Practical component

CC-H1

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VII		
Name of Course	**Physical Chemistry-III**		
Course Code	B-23-CHE-701		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC CC-H1		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Enable to understand the partial molar properties and its use in calculating thermodynamic properties. 2. To learn about role of activity and fugacity for predicting thermodynamic properties and learn about surface chemistry. 3. Get knowledge about the various theories of reaction rate and models to measure order of reaction. 4. To understand the Debye-Huckel theory for ion-ion interaction in week and strong electrolytic systems.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Partial Molar Properties** Recapitulation of thermodynamic laws, Partial molar quantities, chemical potential and Gibbs-Duhem equation, variation of chemical potential with temperature and pressure, chemical potential for an ideal gas, chemical potential of ideal gas mixture(s), determination of partial molar volume, thermodynamic functions of mixing (free energy, entropy, volume and enthalpy), concept of escaping tendency and chemical potential.	15
II	**Real Gases: Concept of Fugacity and Activity** Concept of fugacity, methods for determining the fugacity of a real gas, its variation with temperature and pressure, activity, choice of standard states, dependence of activity on temperature and pressure, determination of activity by (i) measurement of vapour pressure, (ii) distribution of solute between two immiscible solvents and (iii) emf measurement. **Surface Chemistry and Catalysis** Gibbs adsorption equation, Langmuir adsorption isotherm (LAI) and its derivation for non-dissociative and dissociative adsorption, Heterogeneous catalysis, Kinetics of Bimolecular surface reactions using LAI for different cases. Catalysis for environment protection – catalytic convertor for automobiles.	15
III	**Chemical Kinetics** Collision theory of reaction rates, the steric requirement, Arrhenius equation and activated complex theory (ACT), Equilibrium hypothesis, Statistical mechanics and Chemical Equilibrium, Comparison of Collision and Activation complex theory, Potential energy surfaces (Only basic Idea), Thermodynamic formulation of activated complex theory, Chain reactions (hydrogen-halogen reaction), Unimolecular reactions: Lindemann-Christiansen Hypothesis, Hishelwood treatment.	15
IV	**Electrochemistry** Debye-Hückel theory of ion-ion interaction and activity coefficient, applicability and limitations of Debye-Hückel limiting law, its modification for finite-sized ions, effect of ion-solvent interaction on activity coefficient. Physical significance of activity coefficients, mean activity coefficient of an electrolyte. Debye-Huckel-Onsager (D-H-O) theory of electrolytic conductance, Debye-Falkenhagen effect, Wein effect. D-H-O equation - its applicability and limitations, Pair-wise association of ions (Bjerrum treatment), Modification of D-H-O theory to account for ion-pair formation.	15
Evaluation:		

Internal Assesment: 30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Pub.
2. Physical Chemistry, P.W. Atkins, Oxford University Press.
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East-West Press.
4. Thermodynamics, I.M. Klotz and R.M. Rosenbers, Benzamin.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Kinetics and Mechanism, A. A. Frost and R.G. Pearson, John Wiley and Sons.
7. Electrochemistry, S. Glasstone, Affiliated East-West Press.
8. Physical Chemistry, G.W. Castellan, Narosa.
9. Heterogeneous Catalysis: Fundamentals and Applications, Julian R.H. Ross, Wiley-VCH; 2nd, Revised and Enlarged Edition edition (October 1, 2007).
10. Concepts of Modern Catalysis and Kinetics, I. Chorkendorff and J. W. Niemantsverdriet.

CC-H2

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VII		
Name of Course	**Inorganic Chemistry-III**		
Course Code	B-23-CHE-702		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC CC-H2		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To understand advanced symmetry concepts of chemical molecules and its applications, identify the axis, plane, center and point group, polarity, dipole moment, product of symmetry operation and character table of chemical compounds. 2. To have an idea about Stereochemistry and Bonding in Main Group Compounds 3. Get knowledge about the Stepwise and overall formation constants and their interaction, Substitution reactions in octahedral complexes, theories of trans effect with example of Pt(II) complex 4. To understand the basic idea of Crystal field theory and MOT with octahedral, tetrahedral and square planar complexes		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Symmetry and Group Theory in Chemistry** Definitions of group, subgroup, relation between orders of a finite groups and its subgroups. Conjugacy relation and classes. Symmetry elements and symmetry operations, Point symmetry group. Schönflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, $C_{nh,}D_{nh}$ etc. groups to be worked out explicitly). Character of a representation, reducible and irreducible representations. The great orthogonality theorem (without proof) and its importance, Derivation of character tables of $C_{2v\ and}$ C_{3v} Character tables and their use. Molecular asymmetry, dissymmetry and optical activity.	15
II	**Stereochemistry and Bonding in Main Group Compounds.** VSEPR Theory, Walsh diagrams (Tri-atomic molecules), dπ-pπ bonds, Bent rule and energetic of hybridization, Huckel theory with reference to ethylene and butadiene, Some simple substitution reactions of covalently bonded molecules of boron, silicon and nitrogen.	15
III	**Metal-Ligand Equilibria in Solution** Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. Substitution reactions in octahedral complexes, theories of trans effect with respect to Pt(II) complexes. inert and labile complexes.	15
IV	**Metal-Ligand Bonding** Crystal field theory and its limitation , crystal field effects, John Teller distortion, nephelauxetic series, spin-orbital coupling, molecular orbital theory of octahedral, tetrahedral and square planar complexes (with and without π-bonding).	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination:** **70**

Part C- Learning Resources
Recommended Books/e-resources/LMS:
1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, Harper & Row.
3. Chemical Applications of Group Theory; F.A. Cotton, Wiley, New York.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. The Chemical bond; J. N. Murrel, SFA Kettle and J.M. Tedder; Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H. J. Emeleus and Sharpe.
7. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J. J. Alexander; John Wiley and Sons.
8. Inorganic Chemistry, A Modern Introduction; T Moeller, John Wiley and Sons.
9. Principles of Inorganic Chemistry; B. R. Puri, L. R. Sharma, K. C. Kalia
10. Advanced Inorganic Chemistry, Vol.II; Satya Prakash, G.D. Tuli, S. K. Basu, R. D. Madan.

CC-H3

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VII		
Name of Course	**Organic Chemistry-III**		
Course Code	B-23-CHE-703		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC CC-H3		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To understand the general aspects (theoretical and experimental) of organic reaction mechanism and reaction intermediates. 2. To understand mechanistic details of aliphatic nucleophilic substitution reactions and elimination reactions. 3. To understand the stereo-chemical terms and conformational aspects in cyclic and acyclic system. 4. To understand the important stereochemical terms and aspects related to asymmetric synthesis.Idea about conformations of sugars and decalins.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Reaction Mechanism: Structure and Reactivity** Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, effect of structure on reactivity - resonance and field effects, steric effect, quantitative treatment:The Hammett equation and linear free energy relationship an elementary Idea. Kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates. Generation, structure, stability and reactivity of carbocations, carbanions, carbenes and nitrenes.	15
II	**Mechanism of Nucleophilic Aliphatic Substitution** The limiting cases SN^1 and SN^2, detailed mechanistic description and borderline mechanisms, nucleophilicity and solvent effects, ambident nucleophiles, hard and soft nucleophiles and electrophiles, leaving group effects, steric and other substituent effects on substitution and ionization rates, stereochemistry of nucleophilic substitution. SN^i, $SN^{1'}$, $SN^{2'}$ and $SN^{i'}$ mechanisms. **Mechanism of Elimination Reactions** The El, ElcB and E2 mechanisms, Orientation Effects in Elimination Reactions, Saytzeff and Hoffman rules, Stereochemistry of E2 Elimination Reaction and Eclipsing Effects in E2 Eliminations, Dehydration of Alcohols, Pyrolytic eliminations.	15
III	**Stereochemistry-I** Symmetry elements, D-L, R-S, E-Z and threo-erythro nomenclature, interconversion of Fischer, Newman, Sawhorse and flying wedge formulae. Conformational analysis, enantiomerism and diastereomerism of simple, cyclic (chair and boat conformation) and acyclic systems. Axial and planer chirality, optical isomerism in allenes, biphenyls (atropoisomerism), spiranes, hemispiranes. Elementary ideas about stereochemistry of tertiary amines, quaternary ammonium salts. (Use of molecular models for better understanding ofstereochemistry).	15
IV	**Stereochemistry –II** Topicity of ligands and faces, their nomenclature and prostereoisomerism, stereogenecity, chirogenicity, pseudoasymmetry and prochiral centre. stereospecific and stereoselective reaction.Elementary idea of principle categories of asymmetric synthesis, Cram's rule and Prelog rule. Stereochemistry of sugars- C1 and 1C conformations of hexoses, homomorphous sugars, abnormal mutarotation and Δ-2 instability factor. Stereochemistry of decalins.	15
Evaluation:		

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Organic Chemistry Volume I by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Reaction Mechanism in Organic Chemistry by Mukherji and Singh revised by S.P. Singh and Om Prakash published by Laxmi Publication, New Delhi.
3. Advanced Organic Chemistry Reactions, Mechanism and Structure, Jerry March, John Wiley.
4. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
5. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
6. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
7. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
8. Modern Organic Reactions, H. O. House, Benjamin.
9. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.
10. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
11. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
12. Stereochemistry of Organic Compounds, P.S, Kalsi, New Age International.
13. Stereochemistry of Organic compounds, E.L. Elien, Mc Graw Hills, 1962.

DSE –H1

<table>
<tr><td colspan="4">Session 2025-26</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VII</td></tr>
<tr><td>Name of Course</td><td colspan="3">Advance Chemistry-I</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-704</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-H1</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">400-499</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. To explain definitions of vectors, representation, properties and mathematical operations of vectors.
2. To discuss need, theory and applications of logarithms, execute the knowledge in solving general and chemical problems.
3. Be able to represent equations graphically and perform curve fitting for least squares method, perform binomial expansion.
4. To explain rules of differentiation and be able to find out the derivative of a function by applying various methods of differentiation.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Max. Marks: 100
Internal Assessment Marks: 30
End Term Exam Marks: 70</td><td colspan="3">Examination Time: 03 Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
<u>Note:</u> 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.</td></tr>
</table>

Unit	Topics	Contact Hours
I	**Vectors** Examples of scalar and vectors, definitions of vectors in two, three spaces, representation and simple properties of vectors, addition and subtraction of vectors, vector addition by the method of triangles, resolution of vectors into rectangular components, addition of vectors by components, multiplication and differentiation of vectors. Scalar product of vectors, vector product, concept of normalization, orthogonality and complete set of unit vectors. Illustration of applications to spectroscopy and quantum chemistry.	15
II	**Logarithm** Need for logarithm in chemistry. Theory and application of logarithms for solving general and chemical problems. **Graphical Representation of Equations** Rectangular coordinates, straight lines, slope and intercept of the equation, slope and point equation, two point equation, parallel lines, points of intersection, distance between two points, change of origin. Examples from problems in chemistry, curve fitting for least squares method.	15
III	**Elements of Algebraic and Trigonometric Functions** The binomial expansion, some example from chemistry, sines, cosines and tangents, trigonometric identities, polar coordinates in trigonometric functions. **Differential Calculus** Theory, graphical significance of differentiation, rules of differentiation, Algebraic simplification, Partial differentiation, Exact and inexact differential with their application to thermodynamic principles.	15
IV	**Integral Calculus** Integral theory, methods of integration, viz. algebraic simplifications, integration by substitution, integration by parts, integration by partial fractions, integration between limits, curve sketching, integral as area, , Illustration of application in chemistry. **Differential Equation** Simple differential equations, separable variables, homogeneous equations, exact differential equations, linear differential equations, partial differential equations, application to physico-chemical problems.	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources
Recommended Books/e-resources/LMS:
1. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
2. Mathematical Preparation for General Physics, J.B. Marian, R.C. Davidson Saunder Company.
3. Mathematical Methods for Science Students, G. Stephemen, ELBS.
4. Chemical Thermodynamics, C.E. Reid, Mc Graw Hills, College 0^{th} Edition.

DSE –H1

<table>
<tr><td colspan="4">Session 2025-26</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VII</td></tr>
<tr><td>Name of Course</td><td colspan="3">Advance Chemistry-II</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-705</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-H1</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">400-499</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLOs):</td><td colspan="3">After completing this course, the learner will be able to:
1. To describe the prokaryotic and eukaryotic cell Structure, metabolic processes occurring in cell. Able to discuss the Carbohydrate metabolism-glycolysis, Kreb's cycle, glycogenolysis, glycogenesis pentose phosphate pathway and gluconeogenesis.
2. To analyze the structure and functions of fatty acids, triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids. β-oxidation of fatty acid, Fluid mosaic mode of cell membrane.
3. To understand enzymatic and chemical cleavage of polypeptide chain, sequencing of amino acids in a polypeptide segment, Sanger method, Edman degradation method, concept of denaturation of proteins.
4. To know the concept of the amino acids, peptides and proteins. Able to describe the primary, secondary structure of proteins and forces responsible for holding these structures.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Max. Marks: 100
Internal Assessment Marks: 30
End Term Exam Marks: 70</td><td colspan="3">Examination Time: 03 Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
</table>

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** Structure and biological functions of important monosachharides (excluding detailed conformational analysis) and derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars-N-acetylmuramic acid and sialic acid. Disaccharides- sucrose, lactose and maltose. Structure and biological functions of Structural polysaccharides (cellulose and chitin) and Storage polysaccharides (starch and glycogen) Heteropolysaccharides-glucosaminoglycans/mucopolysaccharides. Glycoconjugates-glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances.	15
II	**Cell Structure and Metabolism** Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes - catabolism and anabolism. ATP - the biological energy currency. Carbohydrate metabolism: glycolysis and Kreb's cycle. **Lipids-I:** Fatty acids, essential fatty acids, structure and functions of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids.	15
III	**Lipids-II:** Lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism - β-oxidation of fatty acids.	15
IV	**Amino-acids, Peptides and Protein** Peptide bond, Chemical and enzymatic hydrolysis of proteins to peptides, Sanger method and Edman degradation method for amino acid sequencing. Secondary structure of proteins-α-helix, β-sheet, forces responsible for holding the secondary structures of proteins. Denaturation of Proteins. **Nucleic Acids and Genetic Code** Structure and functions of nucleotides, nucleosides, DNA (Watson-Crick model, Chargaff's rules) and RNA (m RNA, r-RNA and t-RNA).	15

	Genetic code and its characteristics, codon-anticodon pairing (Wobble hypothesis).	

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
3. Biochemistry, L.Stryer, W.H.Freeman.
4. Biochemistry, J. David Rawn, Neil Patterson.
5. Biochemistry, Voet and Voet, John Wiley.
6. Outlines of Biochemistry, E. E.Conn and P. K. Stumpf, John Wiley.

DSE –H1

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VII		
Name of Course	**Advance Chemistry-III**		
Course Code	B-23-CHE-706		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-H1		
Level of Course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs):	1. To describe the prokaryotic and eukaryotic cell Structure, metabolic processes occurring in cell. Able to discuss the Carbohydrate metabolism-glycolysis, Kreb's cycle, glycogenolysis, glycogenesis pentose phosphate pathway and gluconeogenesis 2. To analyze the structure and functions of fatty acids, triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids. β-oxidation of fatty acid, Fluid mosaic mode of cell membrane 3. To discuss need, theory and applications of logarithms, execute the knowledge in solving general and chemical problems. 4. Be able to represent equations graphically and perform curve fitting for least squares method, perform binomial expansion.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 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** Structure and biological functions of important monosachharides (excluding detailed conformational analysis) and derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars-N-acetylmuramic acid and sialic acid. Disaccharides- sucrose, lactose and maltose. tructure and biological functions of Structural polysaccharides (cellulose and chitin) and Storage polysaccharides (starch and glycogen) Heteropolysaccharides-glucosaminoglycans/mucopolysaccharides. Glycoconjugates- glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances.	15
II	**Cell Structure and Metabolism** Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes - catabolism and anabolism. ATP - the biological energy currency. Carbohydrate metabolism: glycolysis and Kreb's cycle. **Lipids:** Fatty acids, essential fatty acids, structure and functions of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids.	15
III	**Logarithm** Need for logarithm in chemistry. Theory and application of logarithms for solving general and chemical problems. **Graphical Representation of Equations** Rectangular coordinates, straight lines, slope and intercept of the equation, slope and point equation, two point equation, parallel lines, points of intersection, distance between two points, change of origin. Examples from problems in chemistry, curve fitting for least squares method.	15

IV	**Elements of Algebraic and Trigonometric Functions** The binomial expansion, some example from chemistry, sines, cosines and tangents, trigonometric identities, polar coordinates in trigonometric functions. **Differential Calculus** Theory, graphical significance of differentiation, rules of differentiation, Algebraic simplification, Partial differentiation, Exact and inexact differential with their application to thermodynamic principles.	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination:** 70

Part C- Learning Resources

Rec**ommended Books/e-resources/LMS:**

1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
3. Biochemistry, L.Stryer, W.H.Freeman.
4. Biochemistry, J. David Rawn, Neil Patterson.
5. Biochemistry, Voet and Voet, John Wiley.
6. Outlines of Biochemistry, E. E.Conn and P. K. Stumpf, John Wiley.
7. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
8. Mathematical Preparation for General Physics, J.B. Marian, R.C. Davidson Saunder Company.
9. Mathematical Methods for Science Students, G. Stephemen, ELBS.

PC-H1

Session: 2025-26			
Part A - Introduction			
Subject	Chemistry		
Semester	VII		
Name of the Course	**Practical Chemistry**		
Course Code	B-23-CHE-707		
CourseType: (PC/CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	PC-H1		
Level of the course	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the basic concept about the qualitative analysis and identification of cations and anions from a mixture of two acidic radicals, two rare earth metal ions and one insoluble salt. 2. To understand and master the fundamentals and experimentation of chemical kinetics, surface tension, conductometric and potentiometric titrations in aqueous media. 3. To understand the basic laboratory & purification techniques, perform the experimentation of stepwise synthesis of the organic compounds and evaluate results in organic chemistry. 4. To explore the practical applicability of different types of processes/reactions in chemistry and able to face viva-voce after completion of course.		
Credits	Theory	Practical	Total
	0	4	4
Contact Hours	0	8	8
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 06 Hours (May be conducted in two sessions of 3 hrs. each)		
Part B-Contents of the Course			
Practicals			Contact Hours

Section- A (Inorganic Chemistry) 120

Qualitative Analysis:

Total five radicals to be given containing two less common metal ions, one insoluble and two acid radicals: CH_3COO^-, BO_3^{3-}, PO_4^{3-}, CO_3^{2-}, HCO_3^-, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, S^{2-}, SO_3^{2-}, SO_4^{2-}, $S_2O_3^{2-}$, F^-, $C_2O_4^{2-}$.

Less common metal ions- W, Ti, Mo, Se, Ti, Zr, Th, V, U, Ce, Be, (two metal ions in cationic and anionic forms).

Insoluble: halids (AgCl, AgBr, AgI); sulphates ($PbSO_4$, $BaSO_4$) and oxides (Al_2O_3, Cr_2O_3, SnO_2, TiO_2, SiO_2).

Section- B (Physical Chemistry)

Surface Tension:

1. Determine the surface tension of given organic solvents.

Conductometry:

2. Determine the strength of strong acid by conductometric titration with strong base.
3. Determine the strength of weak acid by conductometric titration with strong base.
4. Determine the strength of strong acid and weak acid in a mixture by conductometric titration with strong base.
5. Study precipitation titration between KCl and $AgNO_3$conductometrically. Determine the strength of given solution of $AgNO_3$.
6. Determine solubility and solubility product of sparingly soluble salts like $PbSO_4$, $BaSO_4$.

Potentiometry:

7. Determine the standard electrode potential of Cu and Zn.
8. Determine the strength of a given solution of ferrous ammonium sulphate by potentiometric titration with $K_2Cr_2O_7$ solution.
9. Study the precipitation titration between KCl and $AgNO_3$ potentiometrically.
10. Determine the standard free energy change and equilibrium constant for the reaction

$Cu + 2Ag^+ \rightleftharpoons Cu^{2+} + 2Ag$

Chemical Kinetics:

11. Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
12. Study saponification of ethyl acetate by sodium hydroxide solution using same initial concentration of both the reactants.

Section –C (Organic Chemistry)

Demonstrations of Laboratory & Purification techniques:

Refluxing, Solvent extraction, Purification of solvents and reagents using various techniques like crystallization, distillation, steam distillation, vacuum distillation. Drying and storage of solvents, sublimation etc.

Two-step Preparation of some important organic compounds (involving the reactions out of the followings representative reactions):

- Esterification and saponification
- Oxidation
- Reduction or Hydrogenation
- Partial Reduction
- Nucleophilic substitution
- Aromatic electrophilic substitution reaction
- Condensation reactions
- Hoffman's Bromamide reaction
- Heterocyclic synthesis
- Any other reaction as per requirement

Evaluation:

InternalAssessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
● Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
		Execution	Marks
● Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Write Up (Three exp.)	8×3=24
		Experimentation	12×3=36
1. Mid-Term Exam:	15	Viva	10
		Total	70

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. A Text Book of Macro and Semi-micro Quantitative Analysis, A. I. Vogel, Orient Longman.
2. A Vogel's Text Book of Quantitative Inorganic Analysis, J. Bassett, R. C. Denney, G. B. Jaffery and J. Menaham, Longman, London.
3. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
4. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
5. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
6. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
7. A Hand book of Organic Analysis-Qualitative and Quantitative by H.T. Clarke, and revised by B.Haynee, Edward Arnold, London 1975.
8. Vogel's Text Book of Practical Organic Chemistry by B.S. Furhen et. al., Longman-Group Ltd.
9. Systematic Qualitative Organic Analysis by H. Middleton, Edward Arnold (Publishers) Limited, London 1959.
10. Elementary Practical Organic Chemistry by Arthur I. Vogel, EX CBS Publishers and Distributors.
11. Experiments in Organic Chemistry by Louis, F.Fieser, D.C. Heath and Company Boston, 1955.

CC-HM1

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VII		
Name of Course	**Advanced Minor Chemistry - I**		
Course Code	B-23 CHE-708		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC CC-HM1		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To get the knowledge of water treatment, 2. To understand the concept of pesticides and its applications. 3. Enable to understand the food adulteration and analysis of adulterants in food. 4. To understand the synthesis and applications of commercial polymers.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Water Quality Parameters & treatment**: Water Quality Parameters and Purification Characteristics of water, alkalinity. Hardness: unit of hardness, total solids, oxidation, transparency, silica content. Purification of water for drinking purpose: potability of water, clarification, coagulation, contact and electro chemical coagulation, sterilization and disinfection of water, precipitation, aeration, ozonisation, chlorination. Water Treatment Water softening methods: Clark's process, lime soda process, modified lime soda process, permutit or zeolite process, ion exchange process, demineralization of water.	15
II	**Pesticides**: General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).	15
III	**Food Adulteration andAnalysis of Food Products**: Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals – pesticides and insecticides. Nutritional value of foods, idea about food processing and food preservations and adulteration. Identification of adulterants in some common food items. Analysis of preservatives and colouring matter. Food Standards: ISI, Agmark, FPO, MPO, PFA, FSSAI.	15
IV	**Synthesis and application of Polymers** Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (bakelite, novalac), polyurethanes, silicone polymers, polydienes, polycarbonates. Conducting polymers [polyacetylene, polyaniline, poly(p-phenylene sulphidepolypyrrole, polythiophene)].	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Sharma, B. K., Industrial Chemistry (including Chemical Engineering),

Goel Publishing House, Meerut (2000). 80
2. Varashney, C. K., Water Pollution and Management, 2nd Ed, New Age International (2018).
3. Srivastava, A., Waste Water Treatment and Water Management: Water Treatment and Management, Notion Press (2018).
4. Ghosh, J., Fundamental Concept of Applied Chemistry, S. Chand & Company, New Delhi (2010).
5. Cremlyn R., Pesticide: Preparation and Modes of Action, John Wiley & Sons, New York (1978).
6. Srilakshmi, B., Food Science, 7th Ed., New Age International, New Delhi (2018).
7. Subhalakshmi, G.; Udipi, S. A., Food Processing and Preservation, New Age International, New Delhi (2018).
8. Potter, N. N.; Hotchkiss, J. H., Food Science, 5th Ed., Springer (1999).
9. Sharma, B. K., Industrial Chemistry (Including Chemical Engineering), Goel Publishing House, Meerut (2016).
10. Jayashree Ghosh, Fundamentals concepts of Applied Chemistry, S. Chand Company, 2008.
11. R. D. Madan, Advanced inorganic chemistry, Latest edition 2006.
12. Owen .R. Fennema, Food Chemistry, Marcel Decker Inc., New York 1996.
13. M. Swaminathan, Text Book on Food chemistry, Printing and publishing CO., Ltd. 1993.
14. Billmeyer, F.W., Textbook of Polymer Science, 3rd Ed., Wiley Interscience (2007).
15. Ghosh, P., Polymer Science & Technology, 3rd Ed., Tata McGraw-Hill Education (2017).
16. Gowariker, V. R.; Viswanathan, N. V.; Sreedhar, J., Polymer Science, 3rd Ed., New Age International (2019).

CC-H4

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Physical Chemistry-IV**		
Course Code	B-23-CHE-801		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-H4		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Able to setup and solve Schrödinger equation for H-atom, angular momentum operators and their commutation relations, Ladder operators. 2. Understand basics of X-ray Crystallography and interpret powder XRD patterns of cubic crystals. 3. To understand the kinetics of polymerization. 4. To know the basic concepts of nuclear and radiochemistry. Understand various radiochemical techniques.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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 are allowed.			
Unit	Topics		Contact

		Hours
I	**Quantum Mechanics** Energy levels and wave-functions of Rigid rotator. Hydrogen atom: Complete solution (separation of variables in spherical polar coordinates and its solution). Radial distributions. Angular momentum and its directional quantization, Angular momentum operators, commutation relations, Ladder operators, shapes of atomic orbitals upto d-level and their discussion.	15
II	**X-ray Crystallography** Symmetry elements in crystals, stereographic projections, point groups (illustration of R, R-bar, Rm, R/m, (R-bar)m point groups only), criteria for determining unit cell of lattice, space lattices, space groups P1, Pbar1, P2, $P2_1$, Pm, Pc, C2, Cm, Cc. Bragg's Law, Reciprocal lattice concept and its importance, Definition of Reciprocal lattice vector (derivation excluded). Interplanar spacing using reciprocal lattice concept for cubic, tetragonal, orthorhombic and hexagonal crystal systems, Structure factor calculations for primitive, base-centered, body-centered and face centered unit cells. Relation of structure factor to electron density and intensities (derivation excluded), Interpretation of powder photographs for cubic crystals, Data reduction (Brief overview), Phase problem (definition only), Correctness of a structure (Discrepancy Index).	15
III	**Polymers** Basic concepts, Kinetics of Polymerization: Mechanism and Kinetics of chain growth polymerization: free-radical, cationic, anionic and coordination polymerization. Mechanism and Kinetics of step-growth polymerization. Comparison between step-growth and chain polymerization.Significance of average molecular mass. Poly-dispersity, Molecular mass distribution curves. Determination of molecular mass by viscosity method. Electrically conducting polymers, Flame retardant polymers and Liquid crystal polymers.	15
IV	**Nuclear and Radiochemistry** Nuclear stability and binding energy. Mass and binding energy, Nuclear fission and nuclear fusion, fission cross section, chain fission, fission product and fission yield. Interaction of nuclear radiation with matter, Detectors (Proportional, Geiger-Muller and Scintillation counters) and their principles. Units for measuring radiation absorbed, radiation dosimetry. Radiotracer technique, Activation analysis, isotope dilution technique, Radio chromatography, radiometric titrations, Neutron absorptiometry. Some applications.	15
Evaluation:		

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/ e-resources/LMS:

1. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
2. Quantum Chemistry, I.M. Levine, Prentice Hall.
3. Essentials of Nuclear Chemistry, 4th Edition (1995), H.J. Arnikar, Wiley Eastern, New Delhi.
4. Nuclear & Radiochemistry, 3rd Edition (1981), G. Fridlander, J.W. Kennedy, E. S. Macias, and J. M. Miller, John Wiley, New York.
5. Introduction to Nuclear Chemistry, B. C. Harvey Prentice-Hall (1969).
6. Polymer Chemistry, Billmayer.
7. Polymer Chemistry, Gowarikar.
8. Principles of Polymerization, GerogeOdian.
9. Quantum Chemistry, B. K. Sen, Kalyani Publishers.
10. Quantum Chemistry, R. Prasad, New Age International.

CC-H5

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Inorganic Chemistry-IV**		
Course Code	B-23-CHE-802		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-H5		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know about the electronic transitions occuring in metals and their complexes and also to apply the concept for assignment of absolute configuration in optically active metal chelates andtheir stereochemical information. 2. To explain the synthesis, structuralcharacteristics, chemical properties and reactivity ofmetal π complexes. 3. To know the various classifications of metalcluster compounds and to categories the metalboranes carboranes, metalloboranes andmetallocarboranes and their various aspects. 4. To learn about basic concepts ofphotochemistry viz photochemical laws, quantumyield, electronically excited states, life-timemeasurements and radiative, non radiative processesalong with Franck Condon principle.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Electronic Spectra and Magnetic Properties of Transition Metal Complexes** Electronic arrangements of microstates, calculation of the number of microstates in various electronic arrangements, spectroscopic term symbols, vector diagrams to indicates coupling of orbital angular momenta in p^2, p^3, d^2 configurations and spin orbit coupling for p^2 arrangement, spectroscopic terms, spectral terms of d^2 to d^8 metal ions, determining the ground state terms-Hund's rules, derivation of the term symbols for a closed subshell. Interpretation of electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq, B and b parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.	15
II	**Metal л-Complexes** Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important chemical reactions of metal carbonyls, preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.	15
III	**Metal Clusters** Boranes: Introduction, Nomenclature, synthesis and properties of some important members (B_2H_6, B_4H_{10}, B_5H_9, B_5H_{11} and $B_{10}H_{14}$), bonding in Boranes, STYX code, Borane anions, Carboranes: Introduction, general methods of preparations and important properties, Polyhedral skeletal electron pair theory, Metalloboranes and metallocarboranes :Introduction, general methods of preparation and properties, Isolobal analogy, Metal carbonyl and halide clusters, introduction, Structure and bonding of compounds having M-M bonds, calculation of M-M bond.	15

IV	**Photochemistry** Absorption, absorption spectra, excitation, photochemical laws, quantum yield, electronically excited states- Jablonski Diagrams: Vibrational Relaxation, Internal Conversion, Intersystem Crossing, Fluorescence, and Phosphorescence; Fluorescence Spectra, Rules of fluorescence, Fluorescence Quantum Yield, Franck-Condon principle, Radiative Lifetime. Bimolecular quenching: Stern-Volmer relation, photochemical kinetics, photochemical stages-primary and secondary.	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. Introduction to Ligand fields; B.N. Figgis, Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Introduction to Ligand Field Theory; C.J.Ballahyen, McGraw Hill, New York.
8. Organometallic Chemistry; R.C.Mehrotra and A.Singh, New Age International.
9. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H.McDaniel and J.J. Alexander; John Wiley.
10. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
11. Basic concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
12. Photochemistry of coordination compounds, K.Balzani and V.Carassti, Academic press.
13. Elements of Inorganic Photochemistry; G.J. Ferraudi, Wiley.

CC-H6

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Organic Chemistry-IV**		
Course Code	B-23-CHE-803		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-H6		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the concept of Aromatic Substitution/displacement reactions. 2. To understand the concept of neighbouring group participation and carbocation rearrangements. 3. To describe the generation, structure, stability and reactivity of free radicals and to know the mechanisms of addition to alkenes and alkynes. 4. To understand the concept of addition to carbon hetero atom multiple bonds with emphasis on C=O group.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Aromatic Electrophilic Substitution** Theoretical treatment of aromatic substitution reactions, structure-reactivity relationship in mono substituted benzene ring, energy profile diagram, Vilsmeir-Haak reaction, Reimer-Tiemann reaction, Bischler-Napieralski reaction, Pechmann reaction, Houben-Hoesch reaction, and Fries rearrangement. **Nucleophilic Aromatic Substitution** Mechanism of Nucleophilic substitution in aromatic systems via diazonium ions, by addition-elimination and elimination-addition mechanism (involving arynes); von-Richter rearrangement, Sommelet-Hauser, Stevens and Smiles rearrangements. General aspects of generation, structure, stability and reactivity of arynes.	15
II	**Neighbouring Group Participation and Carbocation Rearrangements** Anchimeric assistance, neighbouring group participation by non-bonding electrons, sigma and -bonds, classical and non-classical carbocations. Carbocations rearrangements: migratory aptitudes, Wagner Meerwein rearrangement, pinacol pinacolone rearrangement, Demjanove rearrangement, Tiffeneau-Demjanov ring expansion, aldehyde-ketone rearrangement, dienone-phenol rearrangement and trans-annular rearrangements and the Stieglitz rearrangement	15
III	**Free Radicals** General aspects of generation, structure, stability and reactivity of free radicals, types of free radical reactions, halogenation including allylic halogenation (NBS), auto-oxidation, decomposition of azo compounds and peroxides, coupling of alkynes, homolytic aromatic substitution, Sandmeyer reaction and Hunsdiecker reaction. **Addition to C-C Multiple Bond** General mechanistic considerations,Mechanism of addition of hydrogen halide, H_2O, halogens, HOX and mercuric salt to alkenes and alkynes. Hydroboration, formation of C-C bonds via organoboranes, hydroboration of acetylenes, nucleophilic addition to alkenes.	15
IV	**Addition to Carbon-Hetero Atoms Multiple Bonds** General mechanistic considerations and reactivity,Hydration and Addition of Alcohols to Aldehydes, Ketones and Acids. Addition - Elimination Reactions of Ketones and Aldehydes, Reactivity of carbonyl compounds towards Addition. Lithium aluminium hydride reduction- carbonyl compounds, acids, esters, nitriles. Additions of Grignard reagents. Reformatsky reaction, Wittig reaction, Claisen condensation, Dieckman reaction, Aldol condensation, Knoevenagal condensation, Perkin reaction, Cannizzaro reaction, Benzoin condensation, Mannich Reaction, Robinson-	15

	Mannichreaction, Ester hydrolysis, aminolysis of esters, amide hydrolysis.	

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Organic Chemistry Volume I, II & III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Reaction Mechanism in Organic Chemistry by Mukherji and Singh revised by S.P. Singh and Om Prakash published by Laxmi Publication, New Delhi.
3. Advanced Organic Chemistry Reactions, Mechanism and Structure, Jerry March, John Wiley.
4. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
5. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
6. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
7. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
8. Modern Organic Reactions, H. O. House, Benjamin.
9. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.
10. Advanced Organic Chemistry and Reaction Mechanisms, Reinhard Bruckner, Academic Press.
11. Organic Chemistry, Jonathan Clayden, Nick Greeves, and Stuart Warren, Oxford University Press.

DSE – H2

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Advanced Chemistry-IV**		
Course Code	B-23-CHE-804		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-H2		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know about basics of analytical chemistry. 2. Aware about the composition and analysis of atmosphere 3. To know about the water quality standards and also the water sampling methods 4. Have idea about the storage and transportation of metal ions in living organisms.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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	**Analytical Chemistry:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures. **Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.	15
II	**Atmosphere** Air pollutants and their types, air quality standards, analysis of CO, NOx, Sox, hydrocarbons, photochemical smog, acid rain, effect of atmospheric pollution, tropospheric chemistry.	15
III	**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods (only theoretical based): i) Determination of pH, activity and alkalinity of water sample. ii) Determination of dissolved oxygen (DO) of a water sample.	15
IV	**Biomineralization, Metal storage and its transportation** Na /K pump, Ferritin, transferrin, and siderophores **Calcium in Biology** Role of Calcium in living cells, its transport and regulation, calcium pump, role of calcium in muscle contraction	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Willard, H.L. Merritt, L.L., Dean, J. & Settle, F.A. Instrumental methods of analysis, 7th Ed. Wadsworth publishing Co. Ltd., Belmont, California, USA, 1988.
2. Chemistry 6th ed., Saunders College Publishing, fort Worth (1992).
3. Harris, D.C. quantitative Chemical Analysis, W. H. Freeman.
4. Dean, J.A. Analytical Chemical Notebook, McGraw Hill.
5. Environmental Chemistry; A. K. De, Wiley Eastern.
6. EnvironmentalPollution Analysis; S. M. Khopkar, Wiley Eastern.
7. Environmental Chemistry; S. K. Banerji: Prentice– Hall.
8. Principles of Bioinorganic Chemistry: S. J. Lippard and J. M. Berg, University Science Books.
9. The Inorganic Chemistry of Biological Process; M. N. Huges; John Wiley & Sons.

DSE – H2

<table>
<tr><td colspan="4">Session 2025-26</td></tr>
<tr><td colspan="4">Part A- Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">VIII</td></tr>
<tr><td>Name of Course</td><td colspan="3">Advanced Chemistry-V</td></tr>
<tr><td>Course Code</td><td colspan="3">B-23-CHE-805</td></tr>
<tr><td>Course Type:
(CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE-H2</td></tr>
<tr><td>Level of Course (As per Annexure-I)</td><td colspan="3">400-499</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3"></td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">1. To know the naming of drugs and various routes of drug administration.
2. To tell about the solid dosage forms, tablets and capsules (soft and hard gelatin capsules.
3. To make to know biphasic liquid dosage forms, Emulsions and suspensions.
4. To deliver the information of monophasic liquid dosage forms, their types and brief description and LD50 and ED50 and therapeutic index.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Max. Marks: 100
Internal Assessment Marks: 30
End Term Exam Marks: 70</td><td colspan="3">Examination Time: 03 Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
<u>Note:</u> 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.</td></tr>
</table>

Unit	Topics	Contact Hours
I	**Introduction** Introduction to Pharmaceutical sciences, its branches, naming of drugs, Generic drugs, routes of drug administration, drug development and its regulation. Introduction of pharmacopeia (IP, BP, USP), introduction of national formularies, typical parts of monograph of Indian pharmacopeia, an introduction to content of IP.	15
II	**Dosage Forms-1** Solid dosage forms: Tablets-Types, granulation, compression, additives used in formulations, coating, evaluation (including dissolution, disintegration, Hardness, Friability, weight variation). Capsules-Soft and hard gelatin capsules, microencapsulation.	15
III	**Dosage Forms-II** Semi solid dosage forms: Introduction, types, brief description of ointments and creams. Biphasic liquid dosage forms: Emulsions and suspensions-types, formulation, methods of preparation, stability. Monophasic liquid dosage forms: Types, brief description of mixtures and syrups.	15
IV	**Toxicology** Introduction, acute and chronic toxicity, LD50 and ED50, therapeutic index, adverse drug effects, dose response relationship, therapeutic drug monitoring, General principles of management of poisoning, antidotes, Treatment of heavy metal poisoning and drugs (barbiturates, benzodiazepines, salicylates, morphine & morphine derivatives, alcohol).	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Foye's principles of medicinal chemistry. David A. Williams, Thomas L. Lemke, Fifth Edition. Lippincott Williams & Wilkins.
2. Essentials of medicinal Pharmacology, K.D.Tripathi, 4th Edition .JaypeeBrothers Medical Publishers Ltd.
3. Medicinal chemistry Vol. I & II. A. Burger, Willey interscience, 1970
4. Pharmacology &Pharmacotherapeutics, Vol. I & II. R.S. Satoskar& S.C. Bhandarkar, Popular Prakashan 1978.

5. A Textbook of medicinal chemistry. P. Parimoo.
6. The Pharmacological Basis of Therapeutics, L.L. Brunton, J.S. Lazo, K.L. Parker 11th ed., Magraw Hill, US, (2006).
7. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
8. Basic and Clinical Pharmacology, Lauge Medical Publication. 1995 B. G. Katzung.
9. Introduction to Pharmacology by P.C. Dandya and S.K. Kulkarni.
10. Cooper and Gunn's Dispensing for Pharmaceutical Students, Ed. S.J. Carter, CBS publishers & distributors.

DSE – H2

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Advanced Chemistry-VI**		
Course Code	B-23-CHE-806		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-H2		
Level of Course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs):	1. To know the naming of drugs and various routes of drug administration. 2. To tell about the solid dosage forms, tablets and capsules (soft and hard gelatin capsules. 3. To know about basics of analytical chemistry. 4. Have idea about analysis of cosmetics.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 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** Introduction to Pharmaceutical sciences, its branches, naming of drugs, Generic drugs, routes of drug administration, drug development and its regulation. Introduction of pharmacopeia (IP, BP, USP), introduction of national formularies, typical parts of monograph of Indian pharmacopeia, an introduction to content of IP.	15
II	**Dosage Forms-1** Solid dosage forms: Tablets-Types, granulation, compression, additives used in formulations, coating, evaluation (including dissolution, disintegration, Hardness, Friability, weight variation). Capsules-Soft and hard gelatin capsules, microencapsulation.	15
III	**Analytical Chemistry:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures. **Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. Ion-exchange: Column, ion-exchange chromatography. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).	15
IV	**Analysis of food products:** Nutritional value of foods, idea about food processing and food preservatives and adulteration. **Analysis of Cosmetics:** Major and minor chemical constituents and their function, analysis of deodorants and antiperspirants, Al, Zn, Boric acid, Chlorides and sulphate base. Determination of constituents of talcum powder, coriander powder and pulses.	15

Evaluation:

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination:** 70

Part C- Learning Resources

Rec**ommended Books/e-resources/LMS:**

1. Foye's principles of medicinal chemistry. David A. Williams, Thomas L. Lemke, Fifth Edition. Lippincott Williams & Wilkins.
2. Essentials of medicinal Pharmacology, K.D.Tripathi, 4th Edition . Jaypee Brothers Medical Publishers Ltd.
3. Medicinal chemistry Vol. I & II. A. Burger, Willey interscience, 1970

4. Pharmacology & Pharmacotherapeutics, Vol. I & II. R.S. Satoskar& S.C. Bhandarkar, Popular Prakashan 1978.
5. A Textbook of medicinal chemistry. P. Parimoo.
6. The Pharmacological Basis of Therapeutics, L.L. Brunton, J.S. Lazo, K.L. Parker 11th ed., Magraw Hill, US, (2006).
7. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
8. Basic and Clinical Pharmacology, Lauge Medical Publication. 1995 B. G. Katzung.
9. Introduction to Pharmacology by P.C. Dandya and S.K. Kulkarni.
10. Cooper and Gunn's Dispensing for Pharmaceutical Students, Ed.S.J. Carter, CBS publishers & distributors.
11. Willard, H.L. Merritt, L.L., Dean, J. & Settle, F.A. Instrumental methods of analysis, 7th Ed. Wadsworth publishing Co. Ltd., Belmont, California, USA, 1988.
12. Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).

PC-H2

Session: 2025-26			
Part A - Introduction			
Subject	Chemistry		
Semester	VIII		
Name of the Course	**Practical Chemistry**		
Course Code	B-23-CHE-807		
Course Type: (PC/CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	PC-H2		
Level of the course	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the basic concept about the quantitative analysis and preparation of some metal salts/complexes. 2. To understand and master the fundamentals and experimentation of Viscosity, refractivity of organic liquids and specific rotation of optically active compounds. 3. To analyse qualitatively the presence of extra elements and functional groups in the binary organic mixture along with understanding of chemical reaction involved, also prepare suitable derivatives. 4. To explore the practical applicability of different types of processes/reactions in chemistry and able to face viva-voce after completion of course.		
Credits	Theory	Practical	Total
	0	4	4
Contact Hours	0	8	8
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 6 Hours (May be conducted in two sessions of 3 hrs. each)		
Part B-Contents of the Course			
Practicals			Contact Hours
Section- A (Inorganic Chemistry) **Quantitative analysis:** Separation of the metal ions and determination of any one of them using			120

volumetric/gravimetric methods.

Cu-Ni, Cu-Zn, Cu-Al, Ca-Ba, Fe-Mg, Fe-Ni etc.

Preparations:

Preparation of the following inorganic compounds and their spectroscopic studies.

I. $Hg[Co(SCN)_4]$
II. $[Cu(NH_3)_4]SO_4.H_2O$
III. Prussian Blue and Turnbull's Blue
IV. $Na[Cr(NH_3)_2(SCN)_4]$
V. $Mn(acac)_3$

Section- B (Physical Chemistry)

Viscosity

- Study the variation of viscosity with concentration for a glycerol solution using Ostwald viscometer and thereafter determine the concentration of unknown solution of glycerol.
- Determination of molar mass of a polymer.

pH-metry

3. Determine the strength of strong acid by pH-metric titration with strong base.

4. Determine the dissociation constant of acetic acid using pH-meter.

Distribution Law

5. Determine the partition coefficient of iodine for distribution between chloroform and water.

6. Determine the formula of the complex formed between copper (II) ion and ammonia using distribution method.

Polarimetry

7. Study the variation of angle of optical rotation with the concentration of any optically active substance (sucrose or glucose) and thereafter determine the unknown concentration of the same substance in given solution.

8. Study the kinetics of inversion of cane-sugar (sucrose) in presence of an acid.

Refractometry

9. Determine the refractive index of simple organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform.

10. Determine the refractivity and molar refractivity of some organic liquids like methyl acetate, ethyl acetate, methanol, ethanol, n-hexane, chloroform.

11. Determine the molar refractivities for CH_2, C, H and Cl.

Section –C (Organic Chemistry)

Organic Mixture Analysis

<table>
<tr><td colspan="3">Demonstrations of separation of binary mixtures: using H_2O, HCl, NaOH, $NaHCO_3$, Ether or other reagent as may be necessary along with required conditions for their use.
Systematic identification of mixtures of pure organic compounds: separation and identification of simple binary mixtures having acidic, basic and neutral components. Preparation of their derivatives, determination of b.p./m.p. for components and their derivatives.</td><td></td></tr>
<tr><td colspan="4">Evaluation:</td></tr>
<tr><td colspan="2">Internal Assessment: 30</td><td colspan="2">End Term Examination: 70</td></tr>
<tr><td>Practicum</td><td>30</td><td>Practicum</td><td>70</td></tr>
<tr><td>● Class Participation:</td><td>5</td><td colspan="2">Lab record, Viva-Voce, write-up and execution of the practical</td></tr>
<tr><td rowspan="3">● Seminar/Demonstration/Viva-voce/Lab records etc.:</td><td rowspan="3">10</td><td>Execution</td><td>Marks</td></tr>
<tr><td>Write Up (Three exp.)</td><td>8×3=24</td></tr>
<tr><td>Experimentation</td><td>12×3=36</td></tr>
<tr><td rowspan="2">• Mid-Term Exam:</td><td rowspan="2">15</td><td>Viva</td><td>10</td></tr>
<tr><td>Total</td><td>70</td></tr>
<tr><td colspan="4">Part C-Learning Resources</td></tr>
<tr><td colspan="4">Recommended Books/e-resources/LMS:
1. A Text Book of Macro and Semi-micro Quantitative Analysis, A. I. Vogel, Orient Longman.
2. A Vogel’s Text Book of Quantitative Inorganic Analysis, J. Bassett, R. C. Denney, G. B. Jaffery and J. Menaham, Longman, London.
3. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
4. Findley’s Practical Physical Chemistry, B.P. Lavitt, Longman.
5. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
6. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
7. Mechanism of Inorganic Reactions; F.Basolo and R.G. Pearson, John Wiley and Sons, New York.
8. Inorganic Chemistry; K.F. Purcell, J.C. Kotz; Holt-Sanders International Editions; Philadelphia. .
9. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
10. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
11. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
12. Coordination Chemistry; Banerjea; Tata McGraw Hill.
13. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J. Alexander; John Wiley and Sons Inc.</td></tr>
</table>

CC-HM2

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Advanced Minor Chemistry – II**		
Course Code	B-23 CHE-808		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC CC-HM2		
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. To know the concept and principles of green chemistry. 2. To get the knowledge of drugs and pharmaceuticals. 3. To understand the food nutrition. 4. To recognize and understand the principles of various characterization techniques.		
Credits	Theory	Practical	Total
	4	0	4
Contact Hours	4	0	4
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70	Examination Time: 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 and Principles of Green Chemistry** Introduction to green chemistry, Need for green chemistry. Goals of green chemistry. Limitations/ obstacles in the pursuit of the goals of green chemistry. Principles of green chemistry and designing a chemical synthesis: Twelve principles of green chemistry with their explanations and examples. Designing a green synthesis using these principles. Prevention of waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products; designing safer chemicals and different basic approaches to do so. Treating water as green solvent.	15
II.	**Drugs and Pharmaceuticals** Drug discovery, design and development, basic retrosynthetic approach. Application of the representative drugs of the following classes: analgesics agents, antipyretic agents, antiinflammatory agents (aspirin, paracetamol, lbuprofen), antibiotics (chloramphenicol), antibacterial and antifungal agents (sulphonamides, sulphanethoxazol, sulphacetamide, trimethoprim), antiviral agents (acyclovir), central nervous system agents (phenobarbital, diazepam), cardiovascular (glyceryl trinitrate), antilaprosy (dapsone), HIV-AIDS related drugs (AZT- Zidovudine).	15
III.	**Constituents of Foods and its additives** Carbohydrates: Classification, Principles involved in the analysis of carbohydrates –estimation of carbohydrates. Proteins: amino acids – peptides – Analysis of proteins –Separation of amino acids by paper chromatorgraphy. Minerals and vitamins: Sources, functions, deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins – classification, sources, Vitamins – A,D,E and K,C,B complex B6 & B12. Food Additives: Artificial sweeteners – saccharin, cyclamate, asparatame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants, Food colours, Emulsifying agents, Preservatives – leavening agents, Baking powder – yeast, Taste enhancers – MSG-vinegar.	15
IV.	Characterization techniques: Theory and applications of UV-visible spectroscopy, Fluorescence spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), IR, Fourier transform infrared (FTIR) spectroscopy, Dynamic Light Scattering (DLS), Powder x-ray diffraction and contact angle.	15
Evaluation:		

Internal Assesment:30 **Theory** ● Class Participation: 5 ● Seminar/presentation/assignment/quiz/class test etc: 10 ● Mid Term Exam: 15	**End Term Examination: 70**
Part C- Learning Resources	
Recommended Books/e-resources/LMS: 1. Anastas, P. T.; Warner, J. C., Green Chemistry: Theory and Practice, Oxford University Press, Oxford (2005). 2. Ahluwalia, V. K.; Kidwai, M. R., New Trends in Green Chemistry, Springer India, New Delhi (2012). 3. Matlack, A., Introduction to Green Chemistry, 2nd Ed., CRC Press (2016). 4. Cann, M. C.; Connely, M. E., Real-World cases in Green Chemistry, American Chemical Society, Washington (2000). 5. Lancaster, M. Green Chemistry: An Introductory Text, 3rd Ed., RSC Publishing (2016). 6.Lemke, T. L.; Zito, S. W.; Roche, V. F.; Williams, D. A., Essentials of Foye's Principles of Medicinal Chemistry. Wolters Kluwer India, New Delhi (2016). 90 7. Patrick, G. L., An Introduction to Medicinal Chemistry. 5th Ed.; Oxford University Press, New Delhi (2013). 8. Singh, H.; Kapoor, V. K., Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, New Delhi (2012). 9. Owen .R. Fennema, Food Chemistry, Marcel Decker Inc., New York 1996. 10. M. Swaminathan, Text Book on Food chemistry, Printing and publishing CO., Ltd. 1993. 11. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch. 12. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle 13. C.N. Banwell: Fundamentals of Molecular Spectroscopy	

Dissertation / Project

Session 2025-26			
Part A- Introduction			
Subject	Chemistry		
Semester	VIII		
Name of Course	**Dissertation / Project in Chemistry**		
Course Code	B-23 CHE-809		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)			
Level of Course (As per Annexure-I)	400-499		
Pre-requisite for the course (if any)			
Credits	Dissertation / Project	Viva-Voce Examination	Total
	8	4	12
Max. Marks:	200	100	300
Part B			

Instructions

Note: Refer to clause 5.15 Project / Dissertation of the ordinance as given below

5.15 Project/Dissertation

A student of fourth-year Bachelor Degree (Honours with Research) Programme will be required to work on the Research Project or do research during eighth semester. The Project/Dissertation work will be of 12 credits.

(i) A student, who has been admitted in Honours with Research Programme, shall submit a request for allotment of a supervisor mentioning her/his research areas of interest in order of preference to the Chairperson/Principal/Director during seventh semester. The Department/College/Institute will allot a qualified supervisor to guide the student for doing research during Project/Dissertation work. A regular full time teacher of that Department/College/Institute, who has been approved to supervise Ph.D scholars by the university, will be eligible to guide the students of Honours with Research programme of that institution.

(ii) The student will submit the synopsis to the supervisor. In case of University Teaching Department (UTD) the synopsis will be approved by the departmental research advisory committee after recommendation of the supervisor. In other cases, the Principal/Director of College/Institute shall constitute a committee for this purpose at the College/Institute level. External experts may be involved wherever sufficient qualified regular teachers are not

available.

(iii) The student shall be required to submit three hard copies of her/his dissertation along with soft copy as PDF file to the Department/College/Institute by 30th June of the concerned year. The late submission can be allowed with late fees as decided by the university fromtime to time.

(iv) The Anti-plagiarism policy of the university is to be strictly followed by thecandidate and the supervisor. Similarity report as per Anti-plagiarism policy of theuniversity is to be annexed with the dissertation.

(v) Evaluation of the dissertation shall be done by an external examiner. The dissertation work will be of total 12 credits (300 marks) and evaluation will be done in two components; report of dissertation (8 credits = 200 marks) and open viva-voce examination (4 credits=100marks).

VOC

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III, V		
Name of the Course	Business Chemistry		
Course Code	B23-VOC-125		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the concepts of business; 2. Logically think about role of chemistry in emerging global economies; 3. Get to know about the case-studies of successful business ideas in chemistry; 4. Deeply learn about intellectual property rights and patents. _____ 5*. Understand way to deal with industrial market working principles.		
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: Theory: Three Hours** **Practicum: Three Hours**	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u>			

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.		
Unit	**Topics**	**Contact Hours**
I	**Business Basics** Key business concepts, Business plans, Market need, Project management, Routes to market, Concept of entrepreneurship, different fields explorable as entrepreneurship in chemistry	12 Hrs
II	**Chemistry in Industry** Current challenges and opportunities for the chemistry-using industries, Role of chemistry in India and global economies, Role of Chemistry in achieving SDG, opportunities in Green Chemistry and business	11Hrs
III	**Making money** Treasures hidden in Chemistry (project), Case study of Successful business ideas in chemistry, Pharmaceutical Chemistry, Plastic Industry, Nutritional Chemistry, Case study of Innovations in chemistry, financial aspects of business with case studies	11Hrs
IV	**Intellectual property** Concept of intellectual property, Novelty, State of Art, Innovations, Technology Transfer, Application, PCP, Geographical Indicators, Traditional Knowledge, Design and Trademark, Patents, Careers in Intellectual property Rights.	11Hrs
V*	A visit to any one Industry/Plant 1. Pharmaceutical Industry to analyse financial layout of project and markets. 2. Paint Industry to analyse financial layout of project and markets. 3. Milk Plant to analyse financial layout, different milk products and markets. 4. Any other Industry to analyse financial layout of project and markets.	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: 20+10*=30 ➢ **Theory: 20** ● Class Participation: 05 ● Seminar/presentation/assignment/quiz/class test etc.:05 ● Mid-Term Exam: 10 ➢ **Practicum:10** ● Class Participation: 05 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 05 ● Mid-Term Exam: N. A.	**End Term Examination: 70 (50+20*)**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Lawerence I. Nwaeke, Business Concepts and Perspectives
- ✓ Titus De Silva, Essential Management Skills for Pharmacy and Business Managers
- ✓ N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).

*Applicable for courses having practical component.

VOC

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	III, V		
Name of the Course	Chemistry of Fertilizers and Pesticides		
Course Code	B23-VOC-122		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Know about fertilizers and nutrients; 2. Understand types of nitrate fertilizers; 3. Understand types of phosphate fertilizers: 4. Get the knowledge about pesticides. 5*. Understand the issues involved in pesticides and fertilizers		
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:Theory: 50 + 20***		**Time: Theory: Three Hours** **Practicum: Three 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.		
Unit	**Topics**	**Contact Hours**
I	Methods and time of fertilizer applications, tips to get best efficiency of Applied fertilizers, Integrated nutrient management, fertilizers and its relations to plant nutrients, Factors effecting optimum fertilizer dose.	12 Hrs
II	Classification and types of fertilizers, Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride: Introduction, Raw materials, Action of as a fertilizers.	11Hrs
III	Phosphate fertilizers: Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate. Potassic fertilizers (Types and optimum doses)	11Hrs
IV	Pesticides: Classification, synthesis, structure activity relationship (SAR), mode of action, uses and adverse effects of representative pesticides in the following classes: Organochlorines (DDT, Gammaxene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).	11Hrs
V*	1. To carryout market survey of potent pesticides with details as follows: a) Name of pesticide b) Chemical name, class and structure of pesticide c) Type of formulation available and Manufacturer's name d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. 2. To carryout market survey of potent botanical pesticides with details as follows: a) Botanical name and family; b) Chemical name (active ingredient) and structure of active ingredient; c) Type of formulation available and Manufacturer's name; d) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes. 3. Preparation of simple Organochlorine pesticides. 4. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications. 5. To calculate active ingredient in given sample of pesticide formulations as per BIS specifications. 6. Preparation of Neem based botanical pesticides. 7. To study about identification of crops, seeds, fertilizers and pesticides.	30 Hrs

Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS	
Internal Assessment: 20+10*=30 ➢ **Theory: 20** ● Class Participation: 05 ● Seminar/presentation/assignment/quiz/class test etc.:05 ● Mid-Term Exam: 10 ➢ **Practicum:10** ● Class Participation: 05 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 05 ● Mid-Term Exam: N. A.	**End Term Examination: (50+20*)**
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ Gopal Rao: Outlines in Chemical Technology. ✓ Shukla and Pandey: Introduction to Chemical Technology ✓ Perry, A.S.; Yamamoto, I.; Ishaaya, I.; Perry, R.Y.(1998),Insecticides in Agriculture and Environment, Springer-Verlag Berlin Heidelberg. ✓ Kuhr, R.J. ;Derough, H.W.(1976),Carbamate Insecticides: Chemistry, Biochemistry and Toxicology, CRC Press,USA.	

*Applicable for courses having practical component.

VOC

<table>
<tr><td colspan="4">Session: 2024-25</td></tr>
<tr><td colspan="4">Part A – Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Chemistry</td></tr>
<tr><td>Semester</td><td colspan="3">IV</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Agriculture Chemistry</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-VOC-222</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)</td><td colspan="3">VOC</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">100-199</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">---</td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1 Thinks about chemistry involved in agriculture
2 Know about chemical composition of soils;
3 Understand impacts of pollutions on soils and its productivity;
4 Critically think regarding sewage effluents.
_____
5*. Practical training of soil analysis</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>45</td><td>30</td><td>75</td></tr>
<tr><td colspan="2">Max. Marks: 70 + 30*
Internal Assessment Marks: 20 +10*
End Term Exam Marks:50 + 20*</td><td colspan="2">Time: Theory: Three Hours
Practicum: Three Hours</td></tr>
<tr><td colspan="4">Part B- Contents of the Course</td></tr>
<tr><td colspan="4"><u>Instructions for Paper- Setter</u>
Note: The examiner is requested to set nine questions in all, selecting two</td></tr>
</table>

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.		
Unit	**Topics**	**Contact Hours**
I	Plants as producers: Photosynthesis, pesticides, herbicide, insecticide, fungicide, storage and preservation of agriculture produce, food processing, chemicals (alcohol) from agriculture waste, use of polymers in agriculture	12 Hrs
II	Soil fertility and soil productivity: urea cycle, Organic and inorganic nitrogen (Haber Bosch Process), nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.	11 Hrs
III	Chemical (elemental) composition of the earth's crust and soils, Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity; Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.	11 Hrs
IV	Nature and sources of pollutants acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings. Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal.	11 Hrs
V*	1. pH of Soil 2. determine carbonate and bicarbonate in soil 3. Determine chloride in the soil sample 4. Determine starch in organic manure 5. Determine nitrate in the soil 6. Determine sulphate in the soil 7. To study Seed germination and viability test.	30Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: 20+10*=30 ➢ **Theory: 20** ● Class Participation: 05 ● Seminar/presentation/assignment/quiz/class test etc.:05 ● Mid-Term Exam: 10 ➢ **Practicum:10** ● Class Participation: 05 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 05 ● Mid-Term Exam: N. A.	**End Term Examination: 70 (50+20*)**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Bear RE. 1964. Chemistry of the Soil. Oxford and IBH. Bolt GH &Bruggenwert MGM. 1978. Soil Chemistry. Elsevier. Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons.
- ✓ Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13 Ed. Pearson Edu.
- ✓ Kabata-Pendias A &Pendias H. 1992. Trace Elements in Soils and Plants. CRC Press.
- ✓ Kannaiyan S, Kumar K & Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.
- ✓ Leigh JG. 2002. Nitrogen Fixation at the Millennium. Elsevier.
- ✓ Mengel K &Kirkby EA. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland.
- ✓ Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. Micronutrients in nd Agriculture. 2 Ed. SSSA, Madison.
- ✓ Pierzinsky GM, Sims TJ & Vance JF. 2002. Soils and Environmental nd Quality. 2 Ed. CRC Press.
- ✓ Stevenson FJ & Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.
- ✓ Tisdale SL, Nelson SL, Beaton JD &Havlin JL. 1999. Soil Fertility and th Fertilizers. 5 Ed. Prentice Hall of India.
- ✓ Troeh FR & Thompson LM. 2005. Soils and Soil Fertility. Blackwell.

*Applicable for courses having practical component.

SEC

Session: 2024-25			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Food Adulteration Testing		
Course Code	B23-SEC-404		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Know about common food adulterants 2 Learn methods of detection of adulterants in food 3 Get aware about laws related with adulteration 4 Understand the role of several agencies. _____ 5*. Practically detect adulteration in foods.		
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: Theory: 3 Hours** **Practicum: 3 Hours**	
Part B- Contents of the Course			
<u>Instructions for Paper- Setter</u> 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			

<table>
<tr><td colspan="3">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.</td></tr>
<tr><th>Unit</th><th>Topics</th><th>Contact Hours</th></tr>
<tr><td>I</td><td>Common Foods and Adulteration
Common Foods subjected to Adulteration - Adulteration Definition – Types; Poisonous substances, Foreign matter, Cheap substitutes, Spoiled parts. Adulteration through Food Additives – Intentional and incidental. General Impact on Human Health.</td><td>8 Hrs</td></tr>
<tr><td>II</td><td>Adulteration of Common Foods and Methods of Detection
Means of Adulteration, Methods of Detection Adulterants in the following Foods; Milk, Oil, Grain, Sugar, Spices, Processed food, Fruits and vegetables. Additives and Sweetening agents (at least three methods of detection for each food item).</td><td>8 Hrs</td></tr>
<tr><td>III</td><td>Present Laws and Procedures on Adulteration
Highlights of Food Safety and Standards Act 2006 (FSSA) –Food Safety and Standards Authority of India–Rules and Procedures of Local Authorities.</td><td>7 Hrs</td></tr>
<tr><td>IV</td><td>Role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies, Private testing laboratories, Quality control laboratories of consumer co-operatives. Consumer education, Consumer’s problems rights and responsibilities, COPRA 2019 - Offenses and Penalties – Procedures to Complain – Compensation to Victims.</td><td>7 Hrs</td></tr>
<tr><td>V*</td><td>1. Determination of urea & starch in milk.
2. Determination of starch in Khoa products.
3. Determination of Margarine in Ghee.
4. Determination of Metanil yellow colour in Jaggery.
5. Determination of colored saw dust in turmeric powder.</td><td>30 Hrs</td></tr>
<tr><td colspan="3">Suggested Evaluation Methods
Short Answer and MCQ Type QUESTIONS</td></tr>
<tr><td colspan="2">Internal Assessment: 15+5*
➢ Theory: 15
● Class Participation: 04
● Seminar/presentation/assignment/quiz/class test etc.: 04
● Mid-Term Exam: 07
➢ Practicum: 05
● Class Participation: NIL
● Seminar/Demonstration/Viva-voce/Lab records etc.: 05
● Mid-Term Exam: NIL</td><td>End Term Examination: 55 (35+20*)</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
</table>

Recommended Books/e-resources/LMS:

- ✓ Bright Siaw Afriyie, Introduction to Computer fundamentals.
- ✓ First course in Food Analysis – A.Y. Sathe, New Age International(P)Ltd.,1999
- ✓ Food Safety, case studies – Ramesh. V. Bhat, NIN, 1992
- ✓ https://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/Beverages and confectionary.pdf
- ✓ https://cbseportal.com/project/Download-CBSE-XII-Chemistry-Project-Food-Adulteration#gsc.tab=0
- ✓ https://www.fssai.gov.in/
- ✓ https://indianlegalsolution.com/laws-on-food-adulteration/
- ✓ https://fssai.gov.in/dart/
- ✓ https://byjus.com/biology/food-adulteration/
- ✓ Wikiepedia
- ✓ Vikaspedia

*Applicable for courses having practical component.