KURUKSHETRA UNIVERSITY

KURUKSHETRA

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

Scheme of Examination and Syllabus for

Under-Graduate Programme

Subject: Chemistry

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

DEPARTMENT OF CHEMISTRY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

FIRST YEAR: SEMESTER-1									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A & C	**CC-1 MCC-1 4 credit**	B-23 CHE-101	Chemistry-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme C only	**MCC-2 4 credit**	B-23 CHE-102	Physical Chemistry-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A & D	**CC-M1 2 credit**	B-23 CHE-103	Minor Chemistry-I	2	2	15	35	50	3 hrs.
Scheme A, C & D	**MDC-1 3 credits**	B-23 CHE-104	Introductory Chemistry-I	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
Scheme C only	**CC-M1 4 credit**	From Available CC-I/MCC-I of 4 credits as per NEP							
FIRST YEAR: SEMESTER-2									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A & C	**CC-2 MCC-3 4 credit**	B-23 CHE-201	Chemistry-II	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme C only	**DSEC-1 4 credit**	B-23 CHE-202	Chemistry Skill-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A & D	**CC-M 2 2 credit**	B-23 CHE-	Minor Chemistry-II	2	2	15	35	15	2 hrs.

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Scheme A, C & D	**MDC-2 3 credits**	B-23 CHE-204	Introductory Chemistry-II	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
Scheme C only	**CC-M2 4 credit**	From Available CC-2/MCC-3 of 4 credits as per NEP							
Internship of 4 credits of 4-6 weeks duration after 2nd Semester									

SECOND YEAR: SEMESTER-3									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours / Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A, B & C	**CC-3 MCC-4 4 credit**	B-23 CHE-301	Chemistry-III	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**MCC-5 4 credit**	B-23 CHE-302	Inorganic Chemistry-I	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme A, B, C & D	**MDC-3 3 credits**	B-23 CHE-303	Introductory Chemistry-III	**2**	**2**	**15**	**35**	**50**	**3 hrs.**
			Practical	**1**	**2**	**5**	**20**	**25**	**3 hrs.**
Scheme A, C & D	**CC-M3 4 credits**	**From Available CC-3/MCC-4 of 4 credits as per NEP**							
Scheme B only	**MCC-2**	**MCC-2 FROM SCHEME C OF FIRST SEMESTER Physical Chemistry-I**							

SECOND YEAR: SEMESTER-4									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours / Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A, B & C	**CC-4 MCC-6 4 credit**	B-23 CHE-401	Chemistry-IV	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**MCC-7 4 credit**	B-23 CHE-402	Organic Chemistry-I	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**MCC-8 4 credit**	B-23 CHE-403	Physical Chemistry-II	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Scheme B & C	**DSE-1 4 credit Select one option**	**Elective Chemistry(Select One option)**							
		B-23 CHE-404	Elective Chemistry - I	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-405	Elective Chemistry - II	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23 CHE-406	Elective Chemistry - III	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

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.**
Scheme B & C	**DSE-3 4 credit Select one Option**	**Elective Chemistry (Select One option)**							
		B-23 CHE-506	Elective Chemistry-VII	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
		B-23	Elective	**3**	**3**	**20**	**50**	**70**	**3 hrs.**

		CHE-507	Chemistry-VIII						
			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-605	Elective Chemistry-XII	3	3	20	50	70	3 hrs.
			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	B-23	Organic	4	4	30	70	100	3 hrs.

	4 credit	CHE -703	Chemistry-III						
	Select any one option								
	DSE-6 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	**From Available Minor of 4 credits as per NEP**							

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 -807	Practical Chemistry	**4**	**8**	**30**	**70**	**100**	**6 hrs.**
	CC-HM2 **4 credit**	**From Available Minor of 4 credits as per NEP**							
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**	**-**	**-**	**-**	**-**	**-**
	CC-HM2 **4 credit**	**From Available Minor of 4 credits as per NEP**							

CC-1/ MCC-1

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	I		
Name of the Course	**Chemistry-I**		
Course Code	B23-CHE-101		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Enable to understand the basis of quantum mechanics and structural idea and relevance in describing shapes of s, p and d orbitals. 2. To learn about role of temperature and pressure to establish the state of gases and describe the concept of critical constants of real gases. 3. Get knowledge about the electrophile/nucleophile and its role in mechanism of preparation of organic compounds. 4. To know the physical properties, morphology and crystalline study of liquid and different type of solids. 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	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks: 50+20*		**Time:03 + 03***	

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**Atomic Structure** Dual behaviour of matter and radiation, de Broglie's relation, Heinsenberg's uncertainty principle, concept of atomic orbitals, significance of quantum numbers, radial and angular wave functions, normal and orthogonal wave functions, significance of Ψ and Ψ^2, shapes of s, p, d, f orbitals, Rules for filling electrons in various orbitals, effective nuclear charge, Slater's rules. **Periodic table and atomic properties** Classification of periodic table, definition of atomic and ionic radii, ionisation energy, electron affinity and electronegativity, trend in periodic table (in s and p-block elements), Pauling, Mulliken, Allred Rachow and Mulliken Jaffe's electronegativity scale, Sanderson's electron density ratio.	12
II	**Gaseous State** Kinetic theory of gases, Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity, and most probable velocity. Collision diameter, collision number, collision frequency and mean free path (Derivations excluded), Deviation of Real gases from ideal behaviour, Derivation of Van der Waal' s Equation of State, its application in the calculation of Boyle' s temperature (compression	11

	factor) **Critical Phenomenon** Concept of Critical temperature, critical pressure, critical volume, relationship between critical constants and Van der Waal' s constants (Derivation excluded).	
III	**Structure and Bonding** Localized and delocalized chemical bond, Van der Waals interactions. Concept of resonance and its applications, hyperconjugation, inductive effect, Electromeric effect and their comparison. **Mechanism of Organic Reactions** Curved arrow notation, homolytic and heterolytic bond fission. Types of reagents: electrophiles and nucleophiles. Types of organic reactions: Substitution, Addition, Condensation, Elimination, Rearrangement, Isomerization and Pericyclic reactions. Reactive intermediates: Carbocations, carbanions, free radicals, carbenes (structure & stability).	11
IV	**Liquid State** Structure of liquids, Properties of liquids – surface tension, refractive index, viscosity, vapour pressure and optical rotation. **Solid State** Classification of solids, Law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry and symmetry elements, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of Laue method, rotating crystal method and powder pattern method.	11
V*	1. **Acid/Base titration:** Determination of strength of oxalic acid using NaOH. 2. **Redox titrations:** Determination of Fe^{2+} ions using $KMnO_4$. 3. To determine the surface tension of given liquid using Stalagmometer by drop no. methods. 4. Preparation of *m*-Dinitrobenzne from Nitrobenzene (use 1:2 conc. HNO_3-H_2SO_4 mixture if fuming HNO_3 is not available)	30

	5. Preparation of p-Bromoacetanilide from Acetanilide	

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lee, J.D.; (2010),**Concise Inorganic Chemistry**, Wiley India.
2. Kapoor, K.L. (2015),**A Textbook of Physical Chemistry**, Vol 1, 6 th Edition, McGraw HillEducation.
3. Clayden, J.; Greeves, N.; Warren, S. (2012), **Organic Chemistry**, Oxford.
4. Morrison, R. N.; Boyd, R. N. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015),**Senior Practical Physical Chemistry**, R. Chand &Co, New Delhi.
6. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),**Vogel's Textbook of QuantitativeChemical Analysis,** John Wiley and Sons.

*Applicable for courses having practical component.

MCC-2

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	I		
Name of the Course	**Physical Chemistry-I**		
Course Code	B23-CHE-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of concepts of rates of chemical reactions and its application in determination of order of various reactions. 2. Get the knowledge of various thermodynamic variables and properties. 3. To learn about the concepts of physical and thermodynamic functions in different reversible reactions and get the knowledge of molecular structure. 4. To learn about the various properties of molecules related to its magnetic behavior. 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	45	30	75

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**Chemical Kinetics**: Kinetics Rate of reaction, rate equation and its types, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order and molecularity of a reaction, integrated rate expression for zero order, first order, second and third order reactions (for equal and unequal concentrations of reactants), methods of determination of order of reaction, Half-life period of a reaction. Effect of temperature on the rate of reaction – Arrhenius equation.	12
II	**Chemical Kinetics &Thermodynamics:** Theories of reaction rate – Simple collision theory for unimolecular collision. Transition state theory of bimolecular reactions. Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Thermodynamic equilibrium, Concept of heat and work. First law of thermodynamics: statement, concepts of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship.	11
III	**Thermodynamics, Physical Properties and Molecular Structure-I:** Joule–Thomson coefficient for ideal gas and real gas and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.	11

	Optical activity, polarization – (Clausius – Mossotti equation-derivation excluded). Orientation of dipoles in an electric field, dipole moment, induced dipole moment.	
IV	**Physical Properties and Molecular Structure-II:** Measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetism.	11
V*	1. **Acid/Base titration:** Determination of strength of HCl using NaOH. 2. **Redox titrations:** Determination of $C_2O_4^{2-}$ ions using $KMnO_4$. 3. To determine the surface tension of given liquid using Stalagmometer by drop weight methods. 4. To study the effect of surfactant on surface tension of water. 5. To study the process of sublimation of Camphor and Phthalic acid.	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. Atkins, P.W.; Paula, J.de. (2014),**Atkin's Physical Chemistry Ed**., 10th Edition, OxfordUniversity Press.
2. Ball, D. W. (2017),**Physical Chemistry,** 2 nd Edition,Cengage Learning, India.
3. Castellan, G. W. (2004),**Physical Chemistry**, 4 th Edition, Narosa.
4. Kapoor, K.L. (2015),**A Textbook of Physical Chemistry**, Vol 1, 6 th Edition, McGrawHillEducation.
5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015),**Senior Practical Physical Chemistry**, R. Chand &Co, New Delhi.
6. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P.(2003),**Experiments in Physical Chemistry**, 8 thEdition, McGraw-Hill, New York.

*Applicable for courses having practical component.

CC-M1

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	I		
Name of the Course	**Minor Chemistry-I**		
Course Code	B23-CHE-103		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To understand the basics of Covalent bonding in simple molecules. 2. To get the basics of rates of chemical reactions and factors affecting it. 3. To learn about the nomenclature, classification and methods of preparation of alkenes. 4. To learn about qualitative knowledge of conductors, semiconductors and insulates.		
Credits	Theory	Practical	Total
	2	-	2
Contact Hours	30	-	30
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks:** 35		**Time:03 hrs**	
Part B- Contents of the Course			

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**Covalent Bond** Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear (N_2, O_2) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond.	8
II	**Chemical Kinetics** Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, second order reactions (for equal conc. of reactants), Half-life period of a reaction.	8
III	**Alkanes (upto 5 carbon atoms)** Alkanes, nomenclature, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity.	7
IV	**Metallic Bond and semiconductors** Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors – Introduction, types, and applications.	7

Suggested Evaluation Methods		
Internal Assessment: 15 ➢ **Theory** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7		**End Term Examination:** **35**
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Dhawan S.N.,Organic Chemistry, Vol 1 Pardeep Publication.		

*Applicable for courses having practical component.

MDC-1

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	I		
Name of the Course	**Introductory Chemistry-I**		
Course Code	B23-CHE-104		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To get knowledge about structure and bonding. 2. To learn about hydrocarbons and their applications. 3. To get aware about different polymers. 4. To get knowledge about preservative. 5* To get knowledge about experiments related to daily life.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+25* **Internal Assessment Marks:15+5*** **End Term Exam Marks:** 35+20*		**Time:03 + 03 hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each			

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

Unit	Topics	Contact Hours
I	**Atomic Structure and Bonding** Introduction, Elementary introduction of atomic structure and chemical bonding, Representation of elements/ atoms, Lewis structure, electronic configurations (1-30)	8
II	**Carbon and Its Compounds** Introduction, Tetravalency of Carbon, allotropes of carbon and their properties, hydrocarbons (1-5), nomenclature (linear compounds), Applications of hydrocarbons.	8
III	**Polymers** Introduction, elementary idea of synthetic and natural polymers, Homo polymers and copolymers, uses and properties (Natural rubber, Vulcanized rubber, Polyethene, PVC, Styrene, Teflon, PAN, Nylon-66)	7
IV	**Food Preservatives** Elementary idea of natural and synthetic food preservatives, rancidity, uses and properties, different food preservation processes (pickle, Jam), artificial sweeteners, uses and properties	7
V*	**Practicals:** 1. Identify the pH of the given samples through pH strip. 2. Experiments related to persevering food items. 3. Preparation of Artificail Silk. 4. To senthesize some polymers asper available resources.	30
Suggested Evaluation Methods		

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Dhawan S.N.,Organic Chemistry, Vol 1 Pardeep Publication.

2. Subbulakshmi G, Food processing and preservation, New Age International Publishers.

3. Manas Chanda, 2013, Introduction to Polymer Science and Chemistry 2nd Edition,

Making Rayon Fiber - Artificial silk, chemical experiment!

How to make silk from cotton wool ("Artificial silk" experiment)

Neelam Seedher, Basic Concepts: Physical Chemistry Experiments, Kindley Edition

*Applicable for courses having practical component.

CC-2/MCC-3

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	II		
Name of the Course	**Chemistry-II**		
Course Code	B23-CHE-201		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Able to understand the theories which governs the shape, structure and ionic behavior, polarizability, ionic structures and concept of Lattice energy of crystals of molecules. 2. To know the basics of rates of chemical reactions ,the laws and solubility behavior of solutes in different compositions of solvents 3. To know about alkanes, alkene, cycloalkanes and their chemical reactions. 4. To understand about weak interactions and bonding in metals. 5*. Hand on practice for estimation and determination of viscosity, specific refractivity properties of some compounds.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**Covalent Bond** Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear (N_2, O_2) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond. **Ionic Solids** Ionic structures (NaCl, CsCl, ZnS (Zinc blende), CaF_2) size effects, radius ratio rule and its limitations, Concept of Lattice energy, Born- Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule.	11
II	**Chemical Kinetics** Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, Half-life period of a reaction, Arrhenius equation. **Distribution Law** Nernst distribution law – its thermodynamic derivation, Nernst distribution law after association and dissociation of solute in one of the phases, of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride	12

III	**Alkanes and Cycloalkanes** Nomenclature, classification of carbon atoms in alkanes and its structure. Isomerism in alkanes, sources. Methods of formation: Wurtz reaction, Kolbe reaction, Corey- House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity. Nomenclature of Cycloalkanes, Baeyer' s strain theory and its limitations, theory of strainless r ings. **Alkenes** Nomenclature of alkenes and its structure. Methods of formation: dehydration of alcohols, dehydrohalogenation of alkyl halide, Hofmann elimination and their mechanism. The Saytzeff rule and relative stabilities of alkenes. Chemical reactions: electrophilic and free radical additions, addition of halogens, halogen acids, hydroboration–oxidation, oxymercuration-reduction, ozonolysis and hydration. Markownikoff's rule of addition.	11
IV	**Hydrogen Bonding and Van der Waals forces** Hydrogen Bonding – Definition, types, effects of hydrogen bonding on properties of substances, application Brief discussion of various types of Van der Waals forces. **Metallic Bond and semiconductors** Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors – Introduction, types, and applications.	11
V*	1. **Complexometric titrations:** Determination of Mg^{2+} by EDTA. 2. **Paper Chromatography:** Qualitative Analysis of any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+}, Cu^{2+}, Ni^{2+}, Cl^{-}, Br^{-} , and PO_4^{3-} and NO_3^{-}). 3. To determine the viscosity of given liquid using Ostwald's Viscometer. 4. To determine the specific refractivity of at least two liquids by Refractometer. 5. Separation of mixture of two Organic Compounds by TLC.	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. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India.
2. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6 th Edition, McGraw HillEducation.
3. Clayden, J.; Greeves, N.; Warren, S. (2012), **Organic Chemistry**, Oxford.
4. Morrison, R. N.; Boyd, R. N. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**, R. Chand &Co, New Delhi.
6. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),**Vogel's Textbook of QuantitativeChemical Analysis,** John Wiley and Sons.

*Applicable for courses having practical component.

DSEC-1

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	II		
Name of the Course	**Chemistry Skill-I**		
Course Code	B23-CHE-202		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSEC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Aware about lab handling and handling of hazardous chemicals. 2. Determine percentage purity and knowledge to prepare buffer solutions. 3. To Know preparation of complexometric titration and purification techniques. 4. To get operating knowledge of different instruments. 5*.To get practical knowledge about complexometric titrations and paper chromatography. Also determination some physical properties of some compounds/ solutions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* **Internal Assessment Marks:20+10*** **End Term Exam Marks:** 50+20*		**Time:03+03***	

Part B- Contents of the Course		
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.		
Unit	**Topics**	**Contact Hours**
I	Familiarization with chemical labeling, Handling of hazardous chemicals, Handling of glassware. Sodium metal disposal, Familiarization with chemical concepts related to solution preparation and standardization: Equivalent mass, molar mass, specific gravity, concentration (Normality, Molarity, Molality, %w/v, %w/w, %v/v, ppm, ppb solutions), Basicity, acidity, solutions of oxidizing and reducing agents.	12
II	Determination of concentration and percentage purity. Standardization of solutions, Knowledge about primary and secondary standards. Knowledge about indicators and preparation of indicator solutions, Knowledge about buffers and preparation of buffer solutions.	11
III	Preparation of complexometric solutions (e.g. EDTA solutions) and titrations, Management of chemical waste. Purification of chemicals through distillation, crystallization, sublimation etc. Operating knowledge including calibration, handling and maintenance of Potentiometers and conductometer.	11
IV	Knowledge about different electrodes (e.g., Ag, Pt, SCE, Ag/AgCl) and their upkeep, Operating knowledge including calibration and maintenance of pH-meters and glass electrode, Operating knowledge including calibration and maintenance of refractometer, polarimeter, Flame-photometer, Spectrophotometer, Interferometer and Dipole meter	11
V*	1. **Complexometric titrations:** Determination of Zn^{2+} by EDTA.	30

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

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

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

*Applicable for courses having practical component.

CC-M2

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	II		
Name of the Course	**Minor Chemistry-II**		
Course Code	B23-CHE-203		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To know the basics of periodic properties and hybridization. 2. To learn about the ionic solids. 3. Understand about the semiconductors and metallic bonds. 4. Get the knowledge of stereochemistry of simple organic molecules.		
Credits	Theory	Practical	Total
	2		2
Contact Hours	30		30
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks: 35**		**Time:03 hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter			

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

Unit	Topics	Contact Hours
I	**Periodic table and atomic properties** **Atomic properties**: atomic and ionic radii, ionisation energy, electron affinity and electronegativity definition, methods of determination or evaluation, trend in periodic table, effective nuclear charge, Slater's rules. Directional characteristics of covalent bond, various type of hybridisation and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, SO_4^{-2}, ClO_4^{-1}, NO_3^{-1}	8
II	**Ionic Solids:** Stoichiometric and Non-stoichiometric defects in crystals, Lattice energy and Born- Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule. Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators)	8
III	**Metallic Bond and semiconductors** Semiconductors – Introduction, types, and applications. Structure and Bonding in Organic Compounds Localized and delocalized chemic al bond, Van der Waal's interactions, resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.	7
IV	**Stereochemistry of Organic Compounds** Concept of isomerism. Types of isomerism. Optical isomerism, element s of symmetry, enantiomers, stereo genic centre, optical activity, properties of enantiomers, chiral and achiral molecules (upto two stereo genic centres), diastereomers, threo and erythro diastereomers, meso compounds Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometrical isomerism. Determination of configuration of geometric isomers.	7

V*		

Suggested Evaluation Methods	
Internal Assessment: 15 • **Theory** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7	**End Term Examination:** **35**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009),**Inorganic**
2. **Chemistry- Principles ofStructure and Reactivity**, Pearson ducation.
3. Atkins, P.W.; Paula, J.de. (2014),**Atkin's Physical Chemistry Ed**., 10th Edition, Oxford UniversityPress.
4. Kapoor, K.L.(2015),**A Textbook of Physical Chemistry**,Vol 1, 6 th Edition, McGraw HillEducation.
5. Nasipuri, D.(2018), **Stereochemistry of Organic Compounds: Principles and Applications**, 3 rd Edition, New Age International.
6. Gunstone, F. D. (1975), **Guidebook to Stereochemistry**, Prentice Hall Press.

*Applicable for courses having practical component.

MDC-2

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	II		
Name of the Course	**Introductory Chemistry-II**		
Course Code	B23-CHE-204		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I)	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about role of Indian scientists in the upliftment of research 2.To learn about classification of elements with their properties 3.To learn about three states of matter 4.To get more knowledge about role of fertilizers in fertility of soil 5*.To learn about acid- base reaction in daily life		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+25* Internal Assessment Marks:15+5* End Term Exam Marks: 35+20*		**Time:03+03***	
Part B- Contents of the Course			

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**Renowned Indian Scientists** Brief Biography of Renowned Indian Scientists (Hargobind Khurana, Dr. P.C. Ray, Sir C.V. Raman, Dr. A.P.J. Abdul Kalam, C. N. R. Rao, Dr. Vikram Sara Bhai, Dr. Homi Jahangir Bhabha, Dr. J.C. Bose, Dr. S. N. Bose)	8
II	**Metal and Non-Metals** Periodic table, classification of elements, physical and chemical aspects of metals and non-metals, Ore and Minerals of Iron, Copper, Aluminium, alloys	8
III	**Physical Properties of Matter** Classification of matter, properties, uses, ideal gas equation, real gas equation, some important compounds (baking soda, washing soda, plaster of Paris, gypsum,, glass)	7
IV	**Soil and fertilizers** Green revolution, soil: types of soil and their components for fertility, grow condition, pH, irrigation, biofertilizers, chemical fertilizers and their uses, acid rain.	7
V*	**Practicals:** 1. To prepare Plaster of Paris 2. To prepare Potash Alum 3. To study the effect of acid on Baking and washing soda 4. To perform the action of water on quick lime and identify the nature of reaction (Exo/Endothermic)	30
Suggested Evaluation Methods		

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

Part C-Learning Resources

Recommended Books/e-resources/LMS:

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

*Applicable for courses having practical component.

CC-3/MCC-4

Session: 2023-24	
Part A - Introduction	
Subject	Chemistry
Semester	III
Name of the Course	**Chemistry-III**
Course Code	B23-CHE-301
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	4.0
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about the structure of S and P-block elements, their properties and discuss their use in daily life as well as industrial applications. 2. To understand about various laws and theories related to eletrochemistry-I and know about their thermodynamic properties. 3. To understand about variation of conductance studies with concentration and explain with many phenomenon. 4. The fundamental properties, structures and reactivity of organic compounds such alkene, alkyne arenes, alkyl and aryl halide etc. 5.* Learning about reaction mechanism and predict the outcome of the reactions. 6. How to distinguish between the organic compounds by use of different chemical tests.

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

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**s and p-Block Elements** Salient features of hydrides, oxides, halides, hydroxides of s-block elements (methods of preparation excluded). Structure, preparation and properties of Diborane and Borazine. Catenation, carbides, fluorocarbons, silicates (structural aspects), structure of oxides of Nitrogen and Phosphorous, structure of white and red phosphorus. Structure of oxyacids of Nitrogen, phosphorous, sulphur and chlorine and comparison of acidic strength of oxyacids. low chemical reactivity of noble gases, chemistry of xenon, structure and bonding in fluorides, oxides and oxyfluorides of xenon.	11
II	**Electrochemistry-I** Electrolytic conduction, factors affecting electrolytic conduction, specific conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Application of Kohlrausch' s Law in calculation of conductance of weak electrolytes at infinite dilution (Numericals) Concepts of pH and pK_a, Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action. **Electrochemistry-II**	11

	Reversible & irreversible cells, Calculation of thermodynamic quantities of cell reaction (▲G, ▲H & K). Types of reversible electrodes – metal- metal ion, gas electrode, metal – insoluble salt- anion and redox electrodes. Nernst equation, Standard Hydrogen electrode, reference electrodes, Applications of EMF measurement in solubility product and potentiometric titrations using glass electrode.	
III	**Alkynes** Nomenclature and its structure. Methods of formation: using Calcium carbide, dehydrohalogenation, Kolbe's electrolysis. Chemical reactions: Mechanism of electrophilic and nucleophilic addition reactions, formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis. Acidity of alkynes. **Stereochemistry of Organic Compounds** Concept of isomerism: Structural and Stereoisomerism. Symmetry elements, enantiomers, optical activity, properties of enantiomers, chiral and achiral molecules (up-to 2 asymmetric centres), diastereomers, threo- and erythro- nomenclature, meso-compounds, Relative and absolute configuration, sequence rules, R and S system of nomenclature. Cis- Trans isomerism, E & Z system of nomenclature, Conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds. Newman and Sawhorse projection formulae.	11
IV	**Benzene and its derivatives:** Nomenclature, Aromatic nucleus and side chain, Huckels' rule of aromaticity. Aromatic electrophilic substitution, mechanism of nitration, halogenation, sulphonation, and Friedel- Crafts reaction. Energy profile diagrams. Activating, deactivating substituents and orientation. **Alkyl halides:** Nomenclature, methods of formation: from alkenes and alcohol, nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. **Aryl halides**: Methods of formation: halogenation, Sandmeyer reaction. The addition-elimination, and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl, and aryl halides.	12

V*	1. **Gravimetriic Analysis:** Estimation of Ni^{2+} as Ni-dimethylglyoxime and Al^{3+} as Al-oxinate. 2. **Colorimetry:** To verify Beer-Lambert law for $KMnO_4$ /$K_2Cr_2O_7$ and determine the unknown concentration of the given solution of $KMnO_4$ /$K_2Cr_2O_7$ solution. 3. To prepare acidic and basic buffer solutions of pH 5 and 9 respectively. 4. Preparation of Cuprous chloride, tetra ammine cupric sulphate. 5. To determine the CST of phenol-water system. 6. To determine the solubility of Benzoic acid at various temperatures and to determine the ΔH of the dissolution process. 7. To determine the Enthalpy of neutralisation of strong base Vs strong acid and weak acid/weak base Vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base 8. Determine the rate constant of hydrolysis of ethyl acetate.	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. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India.
2. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6 th Edition, Mc Graw Hill Education.
3. Morrison, R. N.; Boyd, R. N. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. **Organic Chemistry** (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd.

(Pearson Education)

5. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016), **Organic Chemistry**, 12th Edition, Wiley.

6. Clayden, J.; Greeves, N.; Warren, S. (2012), **Organic Chemistry**, Oxford.

7. Nasipuri, D. (2018), **Stereochemistry of Organic Compounds: Principles and Applications**, 3rd Edition, New Age International.

8. Gunstone, F. D. (1975), **Guidebook to Stereochemistry**, Prentice Hall Press.

*Applicable for courses having practical component.

MCC-5

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	**Inorganic Chemistry-I**		
Course Code	B23-CHE-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about the bonding fundamentals for transition elements. 2. To learn on Qualitative ideas of valence bond and bond theories of metallic bond. 3. To learn about general physical properties, reactivities and application of coordination complexes. 4. To get knowledge on General physical properties, reactivities and application of coordination complexes. 5* To learn about on quantitative estimation of Cu^{2+} ions. Also get knowledge to the calculation of ΔH, ΔG and ΔS for dissolving a salts at given temperature.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	Coordination Chemistry: Recapitulation of Werner's Coordination theory. IUPAC nomenclature of coordination Compounds, isomerism in coordination compounds. with coordination numbers 4 and 6. A brief idea about chelate effect and labile and inert complexes.	12
II	Valence bond theory and its application to complexes of coordination numbers 4 and 6. Examples of inner and outer orbital complexes, Crystal field theory, measurement of Δo. Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δo. Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory (for octahedral σ-donor, π- acceptor and π- donor complexes).	11
III	A brief discussion of differences between the first, second and third transition series. Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite. Lanthanoids and Actinoids: A brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties.	11
IV	Inorganic Reaction Mechanism: Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Substitution reactions in square planar complexes, Trans- effect, theories of	11

	trans-effect.	
V*	1. **Gravimetriic Analysis:** Estimation of Cu^{2+}as copper isothiocyanate. 2. **Colorimetry:** To verify Beer-Lambert law for $KMnO_4$ /$K_2Cr_2O_7$ and determine the unknown concentration of the given solution of $KMnO_4$ /$K_2Cr_2O_7$ solution. 3. To prepare acidic and basic buffer solutions of pH 5 and 9 respectively. 4. Preparation of Cuprous chloride, tetra ammine cupric sulphate. 5. To determine the CST of phenol-water system. 6. To determine the solubility of Benzoic acid at various temperatures and to determine the ΔH of the dissolution process. 7. To determine the Enthalpy of neutralisation of strong base Vs strong acid and weak acid/weak base Vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base	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. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India. 2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry, Principles of Structure and Reactivity**, Pearson Education. 3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic**		

Chemistry, John Wiley & Sons.

4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5th Edition, Oxford University Press.

*Applicable for courses having practical component.

MDC-3

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	**Introductory Chemistry-III**		
Course Code	B23-CHE-303		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	Higher secondary other than science discipline		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To learn about different energy resources. 2. To learn about the purification process of water quality 3. To Know more about Pesticides and their bad impacts on health 4. To get more knowledge on the impacts of pollution on environment 5*. To get acquaint about the pH of different food items.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks:50+25* **Internal Assessment Marks:15+5*** **End Term Exam Marks:** 35+20*		**Time:03+03***	
Part B- Contents of the Course			
Instructions for Paper- Setter			

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

Unit	Topics	Contact Hours
I	Pollution and their types: Plastic and polyethene pollution, pollution sources, Recycling of plastic, greenhouse effect, ozone depletion	8
II	Energy: Energy sources, renewable and non-renewable sources, cells and batteries, fuel cell, solar cell, polymer cell	8
III	Water: Sources of drinking water and uses, water conservation, Permissible TDS, Techniques of purification of water, R.O. water purification process (Osmosis and Reverse Osmosis), wastewater management	7
IV	Pesticides and Herbicides: General introduction and definition, biological control and chemical control: natural and synthetic pesticides, benefits and adverse effects of DDT, BHC, malathion.	7
V*	**Practicals:** 1. To check the TDS of different samples of water. 2. Purify the given sample of water using different purification techniques. 3. Identify the pH of different samples of food items. 4. Nutralize the given samples of base using acids	30

Suggested Evaluation Methods

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

Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. **Zero Waste: Management Practices for Environmental Sustainability** by Ashok K. Rathoure 2. **Sustainable Solid Waste Management** by Ni-Bin Chang 3. **Handbook of Advanced Industrial and Hazardous Wastes Treatment** by Lawrence K. Wang (Editor); Nazih K. Shammas (Editor); Yung Tse Hung (Editor) 4. Pesticides and Insecticides, Development and Use, Bobby Jones|2018 5. WATER TREATMENT, How To Make Water Safe To Drink, David Holman 6. Energy,A Beginner's Guide,Vaclav Smil,2017 7. Advanced Physical Chemistry, Practical Handbook, Gurdeep Raj, Edition (2016) 8. Advanced Practical Physical Chemistry, Handbook, J.B.Yadav, Edition (2016) 9. Goyal, P K, Water Pollution Causes, Effects and Control New age International Publishers

*Applicable for courses having practical component.

CC-4/MCC-6

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	**Chemistry-IV**		
Course Code	B23-CHE-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Classify d block and f block elements and also know their properties 2. Learn about the basic idea of analysis with respect to qualitative as well as quantitative measures 3. Know about the first and second law of thermodynamics and also their implications and also know about the concept of chemical equilibrium 4. Know about the alcohols, phenols, aldehydes and ketones with respect to their general characteristics and their important reactions 5*. To get knowledge about identification and confirmation of acidic and basic radicals in a given inorganic salts/mixtures		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	**Chemistry of d-Block elements** Definition of transition elements, General characteristic properties of d-Block elements, Comparison of ionic radii 3d, 4d and 5d series elements, magnetic properties, Stability of various oxidation states and Latimer and Frost diagrams, Structure of some compounds of transition elements- TiO_2, $VOCl_2$, $FeCl_3$, $CuCl_2$ and $Ni(CO)_4$. **Chemistry of f-Block elements** Lanthanide contraction, oxidation states, magnetic properties, complex formation, colour and ionic radii. Actinides: General characteristics of actinides, Transuranic elements, comparison of properties of Lanthanides and actinides with transition elements.	12
II	**Theory of Qualitative and Quantitative Analysis** Chemistry of analysis of various groups of basic and acidic radicals, chemistry of identification of acid radicals in typical combination, common ion effect, solubility product, theory of precipitation, co-precipitation, post precipitation, purification of precipitates.	11
III	**Thermodynamics-I** First law of thermodynamics: statement, concepts of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule– Thomson coefficient for ideal gas and real gas and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.	11

	Second law of thermodynamics, Carnot cycles and its efficiency, Concept of entropy, entropy as a function of V & T, entropy as a function of P & T. **Chemical Equilibrium** Concept of Equilibrium constant, Temperature dependence of equilibrium constant, Clausius–Clapeyron equation and its applications.	
IV	**Alcohols** Monohyric alcohols: nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids, and esters. Hydrogen bonding, Acidic nature, Reactions of alcohols. **Phenols** Nomenclature, structure, and bonding. Preparation: Cumene hydroperoxide method, from diazonium salts, physical properties, and acidic character. Chemical Reactions: — electrophilic aromatic substitution, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction. **Aldehydes and Ketones** Nomenclature and structure of the carbonyl group. Preparation: oxidation of alcohols, from acid chlorides and from nitriles, Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group: benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen and Wolff-Kishner reductions.	11
V*	**Practicals:** 1. To prepare salicylic acid from Aspirin. 2. To prepare m-nitroaniline from m-dinitrobenzene. 3. Semimicro qualitative analysis of mixture containing not more than four radicals (excluding interfering, Combinations and insoluble):Pb^{2+}, Cu^{2+}, Fe^{3+}, Ni^{2+}, Ca^{2+}, NH_4^+, CO_3^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, PO_4^{3-}, SO_4^{2-}	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. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. 009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson ucation.
2. Atkins, P.W.; Paula, J.de. (2014), **Atkin's Physical Chemistry Ed**., 10th Edition, Oxford University Press.
3. Kapoor, K.L.(2015), **A Textbook of Physical Chemistry**,Vol 1, 6 th Edition, McGraw Hill Education.
4. Clayden, J.; Greeves, N.; Warren, S. (2012), **Organic Chemistry**, Oxford.
5. Morrison, R. N.; Boyd, R. N. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Nasipuri, D.(2018), **Stereochemistry of Organic Compounds: Principles and Applications**, 3 rd Edition, New Age International.
7. Gunstone, F. D. (1975), **Guidebook to Stereochemistry**, Prentice Hall Press.

*Applicable for courses having practical component.

MCC-7

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	**Organic Chemistry-I**		
Course Code	B23-CHE-402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand about Amino Acids, Peptides and Proteins Amino acids, Peptides and their classification and their properties 2. Know about the basic structure of proteins with reference to DNA and RNA and also the phenomenon of transcription and translation 3. Learn about basic idea of carbohydrates and lipids including their classification and importance 4. Learn about the Organic Synthesis via Enolates and some simple heterocyclic compounds 5*. To get knowledge about identification and confirmation of acidic basic radicals in a given inorganic salts/mixtures		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	Amino Acids, Peptides and Proteins Amino acids, Peptides, and their classification. α-Amino Acids - Synthesis, ionic properties, and reactions. Zwitterions, pKa values, isoelectric point, and electrophoresis; Study of peptides: determination of their primary structure-end group analysis. Synthesis of peptides using N-protecting, C-protecting, and C- activating groups.	12
II	**Nucleic Acids:** Structure of components of nucleic acids: Bases, Sugars, Nucleosides and Nucleotides. Nomenclature of nucleosides and nucleotides, structure of polynucleotides (DNA and RNA), concept of DNA duplex formation and its characterization. Biological roles of DNA and RNA. Concept of heredity: Genetic Code, Replication, Transcription and Translation.	11
III	**Carbohydrates** Occurrence, classification, and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose 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; Disaccharides – Structure elucidation of maltose and sucrose. **Lipids** Occurrence, classification, and their biological importance. Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value,	11

	acid value, iodine number.	
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.	11
V*	**Practicals:** 1. To prepare salicylic acid from Aspirin. 2. Identification and confirmation of acidic radicals in a given inorganic mixture via Semimicro qualitative analysis of mixture containing not more than two radicals (excluding interfering, Combinations and insoluble): CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_2^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, SO_4^{2-}	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. Morrison, R. N.; Boyd, R. N. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. **Organic Chemistry** (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. \(Pearson Education)
3. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016), **Organic Chemistry**, 12th Edition, Wiley.
4. Bruice, P. Y. (2017), **Organic Chemistry**, 8th Edition, Pearson.
5. Clayden, J.; Greeves, N.; Warren, S. (2012), **Organic Chemistry**, Oxford.
6. Nasipuri, D.(2018), **Stereochemistry of Organic Compounds: Principles and Applications**, 3rd Edition, New Age International.
7. Gunstone, F. D. (1975), **Guidebook to Stereochemistry**, Prentice Hall Press

MCC-8

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	**Physical Chemistry-II**		
Course Code	B23-CHE-403		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Know the concept of phase rule and equillibria with reference to two component system 2. Learn about the Binary solutions and also some theoretical aspects related with this concept 3. Know about the general concept of electrochemistry and also various laws associated with this concept 4. Know about the Concentration cells with and without transference, liquid junction potential and also the basic idea about the surface chemistry 5* To get knowledge about identification and confirmation of basic radicals in a given inorganic salts/mixtures		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

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

Part B- Contents of the Course

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	Statement and meaning of the terms – phase, component and degree of freedom, thermodynamic derivation of Gibbs phase rule, phase equilibria of one component system –Example – water system. Phase equilibria of two component systems solid-liquid equilibria, simple eutectic Example Pb-Ag system, desilverisation of lead.	12
II	Binary solutions: Gibbs-Duhem-Margules equation, its derivation, and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Electrochemical Cells: Rules of oxidation/reduction of ions based on half-cell potentials, Chemical cells, reversible and irreversible cells with examples	11
III	Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy, and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone.	11
IV	Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative	11

	discussion of potentiometric titrations (acid-base, redox). Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich).	
V*	**Practicals:** Identification and confirmation of basic radicals in a given inorganic mixture via Semimicro qualitative analysis of mixture containing not more than two radicals (excluding interfering, Combinations and insoluble): Pb^{2+}, Cu^{2+}, Fe^{3+}, Ni^{2+}, Ca^{2+}, NH_4^+, Al^{3+}, Co^{2+}, Zn^{2+}, Mg^{2+}.	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. Atkins, P.W.; Paula, J.de. (2014), **Atkin's Physical Chemistry Ed**., 10th Edition, Oxford University Press.
2. Ball, D. W. (2017), **Physical Chemistry,** 2nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), **Physical Chemistry**, 4th Edition, Narosa.
4. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 1, 6th Edition, McGraw Hill Education.

*Applicable for courses having practical component.

DSE-1

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	**Elective Chemistry -I**		
Course Code	B23-CHE-404		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Know the basics of polymers, their classification and uses. 2. Get aware of the different methods to calculate the molecular weight of polymers. 3. Know the Properties of Polymers (Physical, thermal, Flow & Mechanical Properties). 4. Have an detail idea about some specific polymers like polyolefin, polystyrene and styrene copolymers, poly (vinyl chloride) _____ 5*. To do the hand on practice in the preparation of polymers and also analysis the role of initiator/binders in the synthesis.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* **Internal Assessment Marks:20+10*** **End Term Exam Marks:** 50+20*		**Time:03+03***	

Part B- Contents of the Course		
Instructions for Paper- Setter **Note:** The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator is allowed.		
Unit	**Topics**	**Contact Hours**
I	Introduction and history of polymeric materials: History of polymeric materials, Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization Bifunctional systems, Mechanism of copolymerization, polymerization techniques	12
II	Determination of molecular weight of polymers (Mn, Mw, etc.) by end group analysis, viscometry, light scattering, and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index Polymer Solution Criteria for polymer solubility and Solubility parameter.	11
III	Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions. Polymer Degradation Thermal, oxidative, hydrolytic and photodegradation, Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).	11
IV	Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers and poly (vinyl acetate), acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite), silicone polymers	11
V*	**Practicals:** 1. To determine the Numer average molecular weight of polymers by viscometry method. 2. To prepare Copolymers using atleast two monomers. 3. Study the role of initiator in the synthesis of polymers.	30

	4. To synthesize the polymers using different binding reagent 5. To determine the weight average molecular weight of polymers by viscometry method.	

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. Hill, J.W.; McCreary, T.W.; Kolb, D.K. (2013), **Chemistry for changing times**, Pearson.
2. Carraher,C. E. Jr. (2013), **Seymour's Polymer Chemistry**, Marcel Dekker, Inc.
3. Odian, G. (2004), **Principles of Polymerization**, John Wiley.
4. Billmeyer, F.W. (1984), **Text Book of Polymer Science**, John Wiley.
5. Ghosh, P. (2001), **Polymer Science & Technology**, Tata Mcgraw-Hill.
6. Lenz, R.W. (1967), **Organic Chemistry of Synthetic High Polymers**, Intersecience (Wiley)
7. Polymer chemistry by Gowarikar
8. Principles of Polymerization by George G. Odian
9. Introduction to Polymer Chemistry by Charles E. carraher
10. Polymer chemistry by Paul C. Hiemenz

*Applicable for courses having practical component.

DSE-1

Session: 2023-24			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	**Elective Chemistry -II**		
Course Code	B23-CHE-405		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Learn the basic concept of Acid base theory. 2. Aware about organometallic chemistry and the uses of metal carbonyls. 3. Having an idea of bioinorganic chemistry and role of different ions in the biological system 4.Get aware about properties of silicones and phosphazenes. 5*. To get knowledge about the functioning of different metal ions in biological system		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks:70+30* **Internal Assessment Marks:20+10*** **End Term Exam Marks:** 50+20*		**Time:03 + 03***	
Part B- Contents of the Course			

Instructions for Paper- Setter

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

Unit	Topics	Contact Hours
I	Acids and Bases Arrhenius, Bronsted-lowry, Lux-flood, solvent system and Lewis concept of acids and bases, relative strength of acids and bases, levelling solvents, hard and soft acids and bases (HSAB), Applications of HSAB principle.	12
II	Organometallic chemistry Definition, classification and nomenclature of organometallic compounds, preparation, properties, and bonding of alkyls of Li, Al, Hg and Sn, concept of hapticity of organic ligand, Structure and bonding in metal-ethylenic complexes, Structure of Ferrocene, classification in metal carbonyls, preparation, properties and bonding in mononuclear carbonyls.	11
III	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, Cooperative effect, Bohr effect.	11
IV	Silicones and Phosphazenes Nomenclature, classification, prepration and uses of silicones, elastomers, polysiloxane copolymers, poly phosphazenes and bonding in triphosphazene.	11
V*	**Practicals:** 1. To analyse the various heavy metal ions present in the various natural and biological samples. 2. To identify and quantify the calcium present in the various biological samples 3. Determination of stability constant of a chelate i.e complex between metal ion and ligand. 4. To identify the different types of contrasting agents and their interactions as used in diagnostic procedures	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. Svehla, G. (1996), **Vogel's Qualitative Inorganic analysis**, 7th Edition, Prentice Hall.
2. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K.(2009), **Inorganic ChemistryPrinciples of Structure and Reactivity**, Pearson Education.
3. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), **Inorganic Chemistry** 2nd Ed**.,** Oxford UniversityPress.
4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5th Edition, W. H. Freeman and Company.
5. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. **Basic Inorganic Chemistry**, 3rd Edition,Wiley India.
6. Greenwood, N.N.; Earnshaw, A.(1997), **Chemistry of the Elements**, 2nd Edition, Elsevier(Ziegler Natta Catalyst and Equilibria in Grignard solution).
7. Powell, P.(1988), **Principles of Organometallic Chemistry**, Chapman and Hall.

*Applicable for courses having practical component.

DSE-1

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	**Elective Chemistry-III**		
Course Code	B23-CHE-406		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of drug development; 2. Learn about several types of drugs; 3. Understand about several types of cardiovascular drugs: 4. To know the basics of nutritional chemistry. 5*. To create and analyse drug molecules.		
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: 03 hrs Practicum: 03 hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter Note: The examiner is requested to set nine questions in all, selecting two questions from each			

SECTION and one question (Question No.1 based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory.		
Unit	**Topics**	**Contact Hours**
I	**Brief history of drug development.** **Definition, uses and side effects of the following categories of drugs:** **Antipyretics, analgesics & anti-inflammatory agents** (paracetamol, asprin, ibuprofen and diclofenac); **Anti-tussive and expectorant** (dextromethorphan, bromhexene); Decongestant (pseudoephedrine, phenylpropanolamine); **Anti-alergic** (Citrizine, Leavocitrizine, diphenhydramine).	12
II	**Definition, uses and side effects of the following categories of drugs:** **Antibacterial drugs** (ampicillin, amoxycillin, cephalexin, ciprofloxacin); **Antimalarial** (Chloroquine, chloroguanide), **Anti-amoebic** (Metronidazole, tinidazole); **Anthelmintic and anti-parasitic** (Mebendazole, Albendazole); **Anticancer** (Chlorambucil, cyclophosphamide), **Antihypertensive** (amlodepin, atenolol);	11
III	**Definition, uses and side effects of the following categories of drugs:** Cardiovascular drugs (sorbitrate, diltiazem). Electrolytes (Sodium, Potassium, Chlorides), Renal (Kidney) Function Tests (Creatinine, Blood urea nitrogen), Liver Function Test (Total Protein (Serum), Bilirubin; direct; indirect; total) Cardiac Markers, Minerals (Calcium, magenisium, Phosphate, Potassium), Blood Disorders (Iron, Vitamin B12, Vitamin D, Folic acid) Miscellaneous (Glucose, Glycosylated hemoglobin, Uric acid).	11
IV	**Nutritional Chemistry** Fat Soluble and water-soluble vitamins (Sources, recommended levels and deficiency diseases; Vitamin A, Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B5, Vitamin B6, Vitamin B7, Vitamin B9, Vitamin B12, Vitamin C, Vitamin D, Vitamin E and Vitamin K). **Daily Intake and Roles in Biological processes of following essential dietary minerals** Major Minerals- Calcium, Phosphorus, potassium, sodium and magenesium; trace elements-sulfur, Iron, Chlorine, cobalt, Copper, Molybdenum, Iodine and Seleneium.	11

V*	1. Preparation of Aspirin and its analysis. 2. Preparation of Paracetamol and its analysis. 3. Preparation of Ibuprofen and its analysis. 4. Preparation of magnesium bisilicate (Antacid).	30
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: 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: ✓ Medicinal chemistry; 7th edition, New age international publisher by Ashutosh Kar ✓ Medicinal chemistry; 3rd edition, Handbook of Nutrition and Food, CRC Press by D. Sriram, P. Yogeshwari, Berdanier, Carolyn D., Dwyer, Johanna T., Heber, and David. ✓ The vitamins: fundamental aspects of nutrition and health; Academic press by G. F. Combs Jr. and G.F. combs Sr ✓ Organic Chemistry, Volume-II, Stereochemistry and the chemistry of natural products by IL Finar, 5th edition, Pearson Education India.		

*Applicable for courses having practical component.

KURUKSHETRA UNIVERSITY

KURUKSHETRA

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

Scheme of Examination and Syllabus for

Under-Graduate Programme:

(VOC, SEC, VAC)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

DEPARTMENT OF CHEMISTRY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours / Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	**VOC**	B23-VOC-122	Chemistry of Fertilizers and Pesticides	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A, B, C & D	**VOC**	B23-VOC-123	Chemistry of Cosmetics and Perfumes	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A, B & C	**VOC**	B23-VOC-222	Agriculture Chemistry	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A, B, C & D	**VOC**	B23-VOC-321	Green Laboratory Practical	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A, B & C	**SEC**	B23-SEC- 205	Chemistry of Food, Flavours and Colorants	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
Scheme A, B, C & D	**SEC**	B23-SEC- 221	Analytical Chemistry	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
Scheme A, B, C & D	**SEC**	B23-SEC- 404	Food Adulteration Testing	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
Scheme A, B & C	**VAC**	B23-VAC- 420	Chemistry in everyday life	2	2	15	35	50	3 hrs.

VOC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
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)	4.0		
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

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry of cosmetics & perfumes		
Course Code	B23-VOC-123		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Get the knowledge of cosmetics; 2. Logically think regarding preparation strategies and uses of cosmetic products; 3. Understand about preparation strategies and uses of cosmetic creams; 4. Get to know about the essential oils preset in nature & their importance towards industrial uses. 5*. learn about practical hands involved in preparation of cosmetic products.		
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			
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	Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, A general study including preparation and uses of the following: Hair dye, Hair spray, Shampoo, conditioners, Suntan lotions.	12 Hrs
II	Preparation and uses of Face powder, Lipsticks, Talcum powder, Nail enamel.	11 Hrs
III	Preparation and uses of creams (cold, vanishing, and shaving creams), Antiperspirants and Artificial flavours.	11 Hrs
IV	Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, Sandalwood oil, Eucalyptus, Rose oil, 2-Phenyl ethyl alcohol, Jasmone, Civetone, Muscone.	11 Hrs
V*	1. Preparation of Talcum powder. 2. Preparation of Shampoo. 3. Preparation of Enamels. 4. Preparation of Hair remover. 5. Preparation of Face cream. 6. Preparation of Nail polish. 7. Preparation of Nail polish remover.	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:

- ✓ E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- ✓ P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- ✓ B.K. Sharma: *Industrial Chemistry,* Goel Publishing House, Meerut.
- ✓ Textbook of Cosmetics; M Vimaladevi; CBS Publishers & Distributors; 2015,
- ✓ ISBN 81-239-1103-3
- ✓ TextBook of Cosmetics; Dr Akanksha Garud, Dr PK Sharma, Dr Navneet Garud; Pragati Prakashan; 2012, ISBN 978-93-5006-691-1
- ✓ Pharmaceutics and Cosmetics; Praveen K. Gupta, Sanjeev K. Gupta; Pragati Prakashan;2011, ISBN 978-81-8398-995-4
- ✓ Chemistry of Cosmetics; R. Kumari; Prestige Publisher, 2018,
- ✓ ISBN 978-81-936512-3-0
- ✓ Formulation Guide For Cosmetics; The Nisshin Oillio Group, Ltd.

*Applicable for courses having practical component.

VOC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Agricultural chemistry		
Course Code	B23-VOC-222		
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)	4.0		
Course Learning Outcomes (CLO):	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 regrading sewage effluents. 5*. Practical training of soil analysis		
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			
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	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.	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:

- ✓ 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.

VOC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	VI		
Name of the Course	Green laboratory practices		
Course Code	B23-VOC-321		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. learn about green chemistry; 2. describe, how injudicious use of chemicals can have an adverse/potentially damaging effect on humans and the environment. 3. propose ideas for innovative approaches to energy challenges. 4. convert biomass into valuable chemicals through green technologies. 5*. Hands on training towards green chemistry		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70 + 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		**Time: 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	Scheme for the traditional as well as green method for the synthesis of ibuprofen. Compare the amount and hazards of waste generated in both Green Methods in Chemistry. Preparation of propene by two methods can be studied (I) Hoffman elimination (II) Dehydration of propanol	11 Hrs
II	Prevention/ minimization of hazardous/ toxic products reducing toxicity. Risk = (function) hazards exposure: (a) Nitration of salicylic acid using green method $Ca(NO_3)_2$ (b) Preparation of dibenzalacetone by cross aldol condensation reaction using base catalysed green method (c) Acetylation of primary aromatic amine using the green method. Use of Green solvents and comparison of greenness of solvents: (a) Introduction to water as a solvent for chemical reactions. preparation of Manganese (III) acetylacetonate using green method (b) Advantages and application of solventless processes in organic reactions. (c) Benzil- Benzilic acid rearrangement in solid State under solvent-free Condition.	12 Hrs
III	Energy requirements for reactions – alternative sources of energy: use of microwaves and photochemical energy. (a) Photoreduction of benzophenone to benzopinacol in the presence of sunlight. (b) Microwave assisted ammonium formate-mediated Knoevenagel reaction: p-anisaldehyde, ethyl cyanoacetate, ammonium formate.	11 Hrs
IV	Importance of using catalytic reagents in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. (a) Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide (b) Rearrangement of diazoamino benzene to p-aminoazo benzene using K10 montmorillonite clay	11 Hrs
V*	1. Dehydration of propanol 2. Nitration of salicylic acid using calcium nitrate 3. Photoreduction of benzophenone to benzopinacol in the	30 Hrs

	presence of sunlight 4. Microwave assisted solvent free synthesis of aspirin 5. Synthesisi of vitamin D3 using photochemical energy	
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:

Theory:

- ✓ Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
- ✓ Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Ed., RSC Publishing.
- ✓ Cann, M.C., Connely, M. E. (2000), Real-World cases in Green Chemistry, American Chemical Society, Washington.
- ✓ Matlack, A.S. (2010), Introduction to Green Chemistry, 2nd Ed., CRC Press.
- ✓ Alhuwalia, V.K.; Kidwai, M.R. (2012), New Trends in Green chemistry, Kluwer Academic Publishers, Springer.
- ✓ Sidhwani, I.T; Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
- ✓ Etzkorn, F. A . (2019), Green Chemistry: Principles and Case Studies, Royal Society of Chemistry.

Practicals:

- ✓ Kirchoff, M., Ryan, M.A. (2002), Greener approaches to undergraduate chemistry experiment, American Chemical Society, Washington DC.
- ✓ Sharma, R.K., Sidhwani, I.T., Chaudhari, M.K. (2013), Green Chemistry Experiments: A monograph, I.K. International Publishing House Pvt Ltd. New Delhi.
- ✓ Pavia, D.L., Lamponam, G.H., Kriz, G.S.W. (2006), Introduction to organic Laboratory Technique- A Microscale approach, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
- ✓ Sidhwani, I.T. ; Saini, G.; Chowdhury, S. Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. University of Delhi, Journal of Undergraduate Research and Innovation, Volume 1, Issue 1, February 2015, ISSN: 2395-2334.
- ✓ Sharma, R. K., Gulati, S., Mehta, S. (2012), Preparation of Gold Nanoparticles Using Tea: A Green Chemistry Experiment, Journal of Chemical Education, 89 (10), 1316-1318.

*Applicable for courses having practical component.

SEC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Chemistry of food flavours and colorants		
Course Code	B23-SEC-205		
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)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Know about basic food components; 2 Analyse the food flavors and pigments; 3 Think about the food additives; 4 Understand about food colorants. 5*. Analyse the extraction & reactions of food components.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	60
Max. Marks: 50+25*= 75 **Internal Assessment Marks: 15+5*= 20** **End Term Exam Marks: 35+20*=55**		**Time: Theory: 3 Hours** **Practicum: 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.		
Unit	**Topics**	**Contact Hours**
I	**Biological molcules in food processing** Water: Physical properties: specific heat, latent heat, vapor pressure, boiling point, water as dispersing medium, states of water, Water in food preparation and preservation Starch: Structure, functional properties - Gelatinization, pasting, syneresis, retrogradation, dextrinization. Factors affecting gelatinization and gelation, c) Gums – Functions, sources, applications. d) Pectic substances, pectin gels	8 Hrs
II	**Enzymes:** a) Biocatalysts, enzyme specificity b) Use of exogenous enzymes in foods – amylases, lipases, proteases c) Endogenous enzymes – phenol oxidases, peroxidases, oxido-reductases, lipoxygenases d) Factors affecting enzyme activity	8 Hrs
III	**Flavours & Pigments** Flavours: a) Molecular mechanism of flavor perception (sweet, bitter, salty, sour, umami, kokumi, pungent, cooling and astringent) b) Flavours from vegetables, fruits, spices, fats and oils, milk and meat products Pigments: a) Pigments in Animal and Plant tissues (Haeme compounds, Chlorophyll, Carotenoids, Anthocyanins, Betalins) b) Synthetic Food Colors (toxicity and regulatory aspects)	7 Hrs
IV	**Food Additives** Additives: a) Buffer systems and salts, chelating agents b) Antioxidants c) Antimicrobials d) Fat replacers, sweeteners e) Masticatory substances f) Firming texturizers g) Clarifying agents, bleaching agents h) Flour improvers, anti-caking agents, i) Gases and propellants.Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Food colorants: sunset yellow, orange-B, citrus red No2, yellow No5, green No3.	7 Hrs
V*	1. Gelatinization of starch granules; 2. To study hydrolysis of starch through salivary amylase 3. To study hydrolysis of fatty acids 4. Extraction of chlorophyll from different leaves;	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: 15 ➢ **Theory** ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➢ **Practicum: 05** ● Class Participation: 02 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 03 ● Mid-Term Exam: NIL	**End Term Examination: 35+20***

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Bright Siaw Afriyie, Introduction to Computer fundamentals.
- ✓ Vacklavick, V. and Christian, E. (2003). Essentials of Food Science. New York: Kluwer Academic/ Plenu Publisher.
- ✓ Damodaran S., Parkin KL. and Fennema OR. Fennema's Food Chemistry (4th Edition), Florida: CRC Press
- ✓ Rick Parker (2003), Introduction to Food Science, New York: Delmar Thomson Learning Borvers, J. (1992).
- ✓ Food Theory and Application (2ndEd), New York: Maxwell MacMillan International Edition.
- ✓ Manay, N. S. and Sharaswamy, S. M. (1997). Foods: Facts and Principles New Delhi: New Age International Publishers.
- ✓ McWilliams, M (2007). Foods: Experimental Perspectives 5th Ed, New Jersey: Macmillar Publishing Co. Potter,
- ✓ N. N. and Hutchkiss, J. H. (1997). Food Science, 5th Ed, New Delhi: CBS Publishers and Distributors.
- ✓ Scottsmith and Hui Y.H (Editiors) (2004) Food Processing – Principles and Applications London Blackwell
- ✓ Carmen Socaciu, "Food Colorants Chemical and functional properties", CRC Press,2007
- ✓ Dr. Geetha Swaminathan & Mrs. Mary George, Laboratory chemical methods in food analysis, Margham Publishers, 2002.

*Applicable for courses having practical component.

SEC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
Name of the Course	Analytical Chemistry		
Course Code	B23-SEC-221		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course (As per Annexure-I	0-99		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Analyse concepts about chromatography & its types; 2. Understand about soil analysis; 3. Learn water purification methods; 4. Perform food processing analysis. 5*. Practically analyse the soil composition.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	30	30	45
Max. Marks: 50+25*= 75 **Internal Assessment Marks: 15+5*= 20** **End Term Exam Marks: 35+20*=55**		**Time: Theory: 3 Hours** **Practicum: 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.		
Unit	**Topics**	**Contact Hours**
I	Chromatography: Definition, general introduction on principles of chromatography, Column chromatography, paper chromatography, TLC& , ion-exchange chromatography.	8 Hrs
II	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.	7 Hrs
III	Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.	8 Hrs
IV	Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.	7 Hrs
V*	1. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). 2. To compare samples of dyes/paints by TLC method. 3. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. 4. Determination of pH of soil samples. 5. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. 6. Determination of pH, acidity and alkalinity of a water	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		
Internal Assessment: 15 ➢ **Theory** ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➢ **Practicum: 05** ● Class Participation: 02 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 03 ● Mid-Term Exam: NIL		**End Term Examination: 35+20***
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

- ✓ E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- ✓ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- ✓ Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
- ✓ Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
- ✓ Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
- ✓ Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
- ✓ Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
- ✓ Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- ✓ Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).
- ✓ Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
- ✓ Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
- ✓ Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

*Applicable for courses having practical component.

SEC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	III		
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	0-99		
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			
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	**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.	8 Hrs
II	**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).	8 Hrs
III	**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.	7 Hrs
IV	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.	7 Hrs
V*	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.	30 Hrs
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		
Internal Assessment: 15 ➢ **Theory** ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➢ **Practicum: 05** ● Class Participation: 02 ● Seminar/Demonstration/Viva-voce/Lab records etc.: 03 ● Mid-Term Exam: NIL		**End Term Examination: 35+20***

Part C-Learning Resources
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.

VAC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	I		
Name of the Course	Chemistry in everyday life		
Course Code	B23-VAC-420		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Critically think about the presence of chemicals in daily life 2. Understand presence of chemicals used in food 3. Analyse importance of Vitamins and minerals 4. Think about general medicines 5*. -NA-		
Credits	Theory	Practical	Total
	2	N. A.	2
Contact Hours	30	N. A.	30
Max. Marks: 50 **Internal Assessment Marks: 15** **End Term Exam Marks: 35**		**Time: 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	**Soaps and detergents, cleansing action of soap, Cleansing action of detergents** **Propellants, Solid propellant, liquid propellants, hybrid propellants dyes: Cause of exhibition of color, chromophore, auxochrome, classification of dyes** **Advanced chemical materials: Ceramics, Sunscreens**	8 Hrs
II	**Chemicals used in foods** Preservatives, coloring agents, sweetening agents, flavoring agents, antioxidants Chemicals used to grow, protect foods and crops: Fertilizers, Fungicides, Herbicide and Insecticide etc.	7 Hrs
III	**Vitamins and minerals** Definition, their significance, **Fat soluble vitamins** Names, daily dietary requirement, natural sources, Deficiency diseases **Water soluble vitamins** Names, daily dietary requirement, natural sources, Deficiency diseases **Minerals** Major and Minor nutrients, daily dietary requirement, natural sources, Deficiency diseases	7 Hrs
IV	**Chemicals in Medicine** Drug - target interaction (enzymes as drug targets and receptors as drug targets), chemical messengers, types of chemical messengers (hormones and neurotransmitters) **Chemotherapy** antipyretics, analgesics, antidepressants' antiseptics and disinfectants, antiviral drugs, antacids, antimalarial, anesthetics, tranquilizers, hypnotics and sedatives, ant allergic drugs and histamines	8 Hrs
V*	**N.A.**	
Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS		

Internal Assessment: ➢ **Theory: 15** ● Class Participation: 04 ● Seminar/presentation/assignment/quiz/class test etc.: 04 ● Mid-Term Exam: 07 ➢ **Practicum Nil** ● Class Participation: ● Seminar/Demonstration/Viva-voce/Lab records etc.: ● Mid-Term Exam:	**End Term Examination: 35**
Part C-Learning Resources	
Recommended Books/e-resources/LMS: ✓ NCERT Chemistry	

KURUKSHETRA UNIVERSITY

KURUKSHETRA

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

Scheme of Examination and Syllabus for

Under-Graduate Programme

Subject: Industrial Chemistry

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

DEPARTMENT OF CHEMISTRY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme for Undergraduate Course Programme, Subject: Industrial Chemistry-Scheme A

FIRST YEAR: SEMESTER-1									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-1 4 credit**	B23-ICH-101	Major Industrial Chemistry-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
FIRST YEAR: SEMESTER-2									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-2 4 credit**	B23-ICH-201	Major Industrial Chemistry-II	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Internship of 4 credits of 4-6 weeks duration after 2nd Semester									

SECOND YEAR: SEMESTER-3									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-3 4 credit**	B23-ICH-301	Major Industrial Chemistry-III	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**

SECOND YEAR: SEMESTER-4									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-4 4 credit**	B23-ICH-401	Major Industrial Chemistry-IV	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

THIRD YEAR: SEMESTER-5									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-5 4 credit**	B23-ICH-501	Major Industrial Chemistry-V	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**
THIRD YEAR: SEMESTER-6									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-6 4 credit**	B23-ICH-601	Major Industrial Chemistry-VI	**3**	**3**	**20**	**50**	**70**	**3 hrs.**
			Practical	**1**	**2**	**10**	**20**	**30**	**3 hrs.**

CC-1

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	I		
Name of the Course	Major Industrial Chemistry-I		
Course Code	B23-ICH-101		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Gain knowledge of various unit operation in chemical technology like distillation, evaporation and filtration 2 Understand catalysis and colloidal Chemistry and their role in various chemical processes. 3 Learn about various metallurgical operations and knowledge about extraction about metals from various ores. 4 Apply material balance with chemical equations in different industries. _____ 5*. Understand good laboratory practices, calibration of apparatuses, apply to prepare standard solution of various concentration and volumetric analysis.		
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: 3 hrs. for Theory and 3 hrs. for Practical**

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two mark.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	**Distillation Unit Process** Introduction, volatility, relative volatility, general equipment for distillation, types of distillation processes, concept of batch and continuous distillation, simple steam distillation, advantages and disadvantages of steam distillation, application of steam distillation in various chemical processes. **Evaporation and Drying** Introduction, factors affecting the rate of evaporation and choice of evaporators, application of evaporation in chemical process industries, equipment- climbing film evaporator, Introduction of drying process, free moisture, bound moisture and equilibrium moisture content, purpose of drying, equipment- rotary dryer.	12 Hrs.
II	**Filtration** Introduction, filter media and filter aids, characteristics of ideal filter aids, factors affecting the rate of filtration and choice of filter media, equipment- bag filters and candle filters. **Absorption** Introduction, desorption or gas stripping, equipment-spray column for absorption. **Material Balance** Introduction, steady and unsteady state of flow processes, material balance equation without chemical reactions, flow/block diagrams for various industrially important chemical engineering operations such as distillation, absorption and	11 Hrs.

	crystallization and their overall material balance equation. (Numerical problems excluded).	
III	**Metallurgical operations** Definition, crushing and pulverization, concentration methods- gravity separation, magnetic concentration, froth flotation process, chemical methods- calcination and roasting, reduction using carbon and carbon monoxide, Alumino thermite reduction, auto reduction, reduction using precipitation method, refining methods polling, parting and electrolyte refining. **Metallurgical Extraction** Metallurgical extraction and refining of the following metals from their important ores: Lead from galena, Aluminum from bauxite and Zinc from Zinc blende.	11 Hrs.
IV	Catalysis: Definition, positive and negative catalyst, homogeneous and heterogeneous catalysis, theories of catalysis- adsorption theory and intermediate complex formation theory, characteristics of catalytic reactions, catalytic inhibitors, catalytic promoters, auto catalysis, introduction to enzyme catalysis, optimum pH and optimum temperature. **Colloidal Chemistry** Colloidal dispersion, definition, types, emulsions and types, applications of emulsions, Gel formation and its types, their importance, micelles, types, preparation and uses.	11 Hrs.
V*	**Practical paper Syllabus: Basic Analytical Techniques** ❖ Good Laboratory Practices, Calibration of thermometer and burette. ❖ Simple Laboratory Techniques: Crystallization, fractional crystallization, distillation, filtration and evaporation. ✓ To purify $CuSO_4$ by the process of crystallization. ✓ To purify Potash Alum by the process of crystallization. ✓ To purify the given organic solvent by distillation process. ✓ To separate the different components of a solid mixture by the process ofFiltration and evaporation. ❖ Standardization of solutions ✓ Prepare and standardize the solution of sodium hydroxide. ✓ Prepare and standardize the given solution of $KMnO_4$. ✓ Prepare and standardize the given solution of hydrochloric acid against standard Sodium hydroxide solution. ✓ Prepare standard solution of $KMnO_4$ and ferrous ammonium sulphate Solution. Find out the strength of unknown ferrous ammonium sulphateSolution.	30 Hrs.

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➢ **Practicum (10 Marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil	**End Term Examination:** 50 Marks 20 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Physical chemistry by B.R Puri, I.R Sharma and M.S Pathania.
- ✓ Study Material in Vocational Subject to Industrial Chemistry (B.Sc. I, UGC) Sponsored (Text Book)
- ✓ Principles of Extractive Metallurgy, Herbashi Vol. 1 and 2.
- ✓ Introduction to Chemical Engineering W.L. Badger and J.T. Banchero, Mc Graw- Hill Book Co.,USA.
- ✓ Unit Operations in Chemical Engineering W.L. McCabe and J.C Smith, Mc Graw- Hill Books co.,New York.
- ✓ Physical Chemistry, G.M. Barrow, Tata McGraw-Hill.
- ✓ Riegel's Handbook of Industrial Chemistry, J.A. Kent, J.A.(ed), CBS Publishers, New Delhi.
- ✓ Saxena Ruchi, Srivastava Alok Kumar, "Read & Do Practical Chemistry", Kitab Mahal, New Delhi, India (2016).
- ✓ Skoog D. A., West. D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia (2010).
- ✓ G. Larry Hargis, "Analytical Chemistry: Principles and Techniques" Pearson© (1988)

Suggested links for e-resources:

- ✓ https://swayam.gov.in/
- ✓ https://nptel.ac.in/courses/112/104/112104113/
- ✓ https://onlinecourses.nptel.ac.in/noc19_ph14/preview
- ✓ http://heecontent.upsdc.gov.in/Home.aspx
- ✓ https://ncert.nic.in/textbook.php?kech1=0-7
- ✓ https://www.labster.com/chemistry-virtual-labs/
- ✓ http://chemcollective.org/vlabs

*Applicable for courses having practical component.

CC-II

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	II		
Name of the Course	Major Industrial Chemistry-II		
Course Code	B23-ICH-201		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Understand fundamental of Organic Chemistry, intermediates and reaction mechanism. 2 Get knowledge of various titration methods to estimate the purity of various compounds. 3 Understand about the various types of fuels, coal and their chemical analysis. 4 Learn about the petroleum industry and its products. 5*. Estimate various natural ores, alloys and other compounds. Analyse and estimate iodine value of an oil sample, saponification value of oil and how to prepare different emulsions.		
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: 3 hrs. for Theory and 3 hrs. for Practical**	

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	**Fundamentals of Organic Chemistry** Cleavage of bonds (homolysis and heterolysis), reaction. intermediates (carbocation, carbanion and free radicals), electrophiles and nucleophiles, inductive effect, electrometric effect, mesomeric effect, resonance effect, hyperconjugation effect and stearic effect. **Halogenation Unit Process** Introduction, types of halogenation reaction, halogenating agents, kinetics and mechanism of halogenation, manufacturing process of chlorobenzene. **Sulphonation Unit Process** Introduction, types of sulphonation reaction, sulphonating agents, commercial sulphonation of alkyl benzene.	12 Hrs.
II	**Titrimetric Analysis** Primary and secondary standards, normality, molarity. Molality, indicators, mixed indicators, neutralization indicators, universal indicators, choice of indicators in neutralization reactions, complexation titrations and precipitation titrations. **Heat Transfer** Introduction, mode of heat transfer, Fourier's law of heat conduction, corrugation, types of corrugation, scraped surface heat exchanger. **Steam** Basic specification of water used for steam production, various applications of steam in industrial processes.	11 Hrs.
III	**Corrosion** Definition, oxidation corrosion, nature of corrosion layer formed, corrosion by hydrogen, concentration cell corrosion, microbiological corrosion, factors influencing corrosion,	

	position of the metal in galvenic series, relative cathodic and anodic area, nature of the surface film formed and nature of the medium. **Corrosion Control** Proper designing, cathodic protection, modification of the environment, use of cathodic and anodic inhibitors.	11 Hrs.
IV	**Fuels** Definition and classification, calorific value, higher or gross calorific value, lower or net calorific value, characteristics of a good fuel. **Coal** Analysis of coal, proximate analysis, determination and importance of moisture content, volatile matter, ash content and fixed carbon. Ultimate analysis, determination and importance of carbon, hydrogen and impurity like sulphur, nitrogen, ash and oxygen in coal. **Petroleum** Fractional distillation of crude oil using fractionating column, cracking- thermal and catalytic cracking of petroleum products, reforming- thermal and catalytic reforming.	11 Hrs.
V*	**Practical paper: Quantitative and Qualitative Analysis** ❖ Analysis of Dolomite ore. ❖ Analysis of Calcite ore. ❖ Analysis of lime stone. ❖ Analysis of Brass sample. ❖ Analysis of Lunar caustic. ❖ Determination of percentage of Fe in Mohr's salt. ❖ Determine the Iodine value of a given oil sample. ❖ Determine the saponification value of a given oil sample. ❖ Prepare a sample of an emulsion- Oil in water. ❖ Prepare a sample of an emulsion – Water in oil.	30 Hrs.
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➢ **Practicum (10 Marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil		**End Term Examination:** 50 Marks 20 Marks

Part C-Learning Resources
Recommended Books/e-resources/LMS: ✓ Study Material in Vocational Subject to Industrial Chemistry (B.Sc. I, UGC) Sponsored (TextBook) ✓ Introduction to Chemical Engineering W.L. Badger and J.T. Banchero, Mc Graw- Hill Book Co.,USA. ✓ Unit Operations in Chemical Engineering W.L. McCabe and J.C Smith, Mc Graw- Hill Books co.,New York. ✓ Physical Chemistry, G.M. Barrow, Tata McGraw-Hill. ✓ Riegel's Handbook of Industrial Chemistry, J.A. Kent, J.A.(ed), CBS Publishers, New Delhi. ✓ Reaction Mechanism in Organic Chemistry, S.P. Singh, OM, Prakash, Trinity Press imprint of Laxmi Publication Pvt. Ltd. ✓ Industrial Chemistry, B.K. Sharma, Krishna's Educational Publishers. ✓ Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher (2009) ✓ Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education (2012). ✓ Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson (2009) ✓ A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford, P.W.G. Smith, Vogel's Textbook of Practical Organic chemistry (1989). **Suggested links for e-resources:** ✓ https://swayam.gov.in/ ✓ https://nptel.ac.in/courses/112/104/112104113/ ✓ https://onlinecourses.nptel.ac.in/noc19_ph14/preview ✓ http://heecontent.upsdc.gov.in/Home.aspx ✓ https://ncert.nic.in/textbook.php?kech1=0-7 ✓ https://www.labster.com/chemistry-virtual-labs/ ✓ http://chemcollective.org/vlabs

*Applicable for courses having practical component.

CC-3

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	III		
Name of the Course	Major Industrial Chemistry-III		
Course Code	B23-ICH-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1 Understand about various inorganic chemical industries like ceramics, refractories, glass and cement industry. 2 Apply knowledge of various material balance equation involving chemical reactions. 3 Apply skill related to various pollutants from the industries, their statutory limit and knowledge about air pollution, pesticide pollutions, noise pollution and radiation pollution. 4 Understand about unit process of crystallization in various industries. 5*. Analyze alkalinity, acidity, hardness, permanent hardness, temporary hardness, total solids, dissolve solids, suspended solids and dissolved oxygen of water. Students will create various organic compounds in lab.		
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: 3 hrs. for Theory and 3 hrs. for Practical**	

Part B- Contents of the Course		
Instructions for Paper- Setter The examiner is requested to set 9 questions in all. 1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks. 2. Eight questions will be set from all four sections by selecting two questions from each section. Students should attempt four more question by selecting one question from each section. Each question carry equal marks.		
Unit	**Topics**	**Contact Hours**
I	**Ceramic Industry** Introduction, types of clay products, properties of clay, plasticity of clay, manufacturing of white wares, applications of white wares. **Refractories** Introduction, classification, properties of refractories body, manufacturing of silica bricks, high alumina bricks, dolomite bricks, carbon bricks, graphite bricks and their applications. **Cement Industry** Introduction, types of cement, chemical composition Portland cement, manufacturing process of Portland cement.	12 Hrs.
II	**Crystallization** Introduction, concept of super saturation, nucleation, primary nucleation and secondary nucleation, crystal growth, caking of crystals, factors affecting caking and prevention of caking, equipment- circulating liquid evaporator crystallizers. **Material balance involving chemical reactions** Introduction, conceptual study of terms involved- stoichiometric equation, stoichiometric coefficients, limiting reactant, excess reactant, conversion, recycling operations and need for their adoption in process industries.	11 Hrs.
III	**Air pollution** Air pollutants gases- sulphur dioxide, sulphur trioxide, oxides of nitrogen, carbon monoxide, particulate matter- dust, smoke, smog their sources and bad effects, remedial measures to control air pollution, processing of air using electrostatic precipitator. Greenhouse effect and its consequences, deforestation and its consequences. Industrial specification and uses of air. **Thermal pollution**	11 Hrs.

	Definition, sources of thermal pollution and bad effects of thermal pollution.	
IV	**Noise pollution** Definition, noise level bearable limit, sources of noise pollution, bad effects of noise pollution and prevention of noise pollution. (4Hrs) **Pesticide pollution** Classification of pesticides, sources of pesticides pollution, bad effects of pesticides and control measures of pesticides pollution. **Radiation pollution** Sources, hazards of nuclear radiations and methods of disposal of radioactive waste.	11 Hrs.
V*	**Practical paper: Water Analysis and Organic Synthesis** ❖ Determination of alkalinity of given water sample. ❖ Determination of acidity of given water sample. ❖ Determination of total hardness of given water sample. ❖ Determination of temporary and permanent hardness of water sample. ❖ Determination of dissolved oxygen of given water sample. ❖ Determination of calcium ions in a given water sample. ❖ To prepare a pure sample of m-dinitrobenzene. ❖ To prepare a pure sample of anthraquinone from anthracene. ❖ To prepare a pure sample of 1-phenyl azo B naphthol. ❖ To prepare a pure sample of anthranilic acid from phthalic anhydride	30 Hrs.

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➢ **Practicum (10 Marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil	**End Term Examination:** 50 Marks 20 Marks

Part C-Learning Resources
Recommended Books/e-resources/LMS: ✓ Industrial Chemistry, B.K. Sharma, GoeL, Publishing House. ✓ Industrial Pollution and Environmental Management, R.K, Trivedy, N.S. Raman, Scientific Publishers Journals. Environmental and Pollution Science, M. Brusseau, I. Pepper, C. Gerba, Third Edition, Elsevier Science. ✓ Study material in Vocational subject of Industrial Chemistry (B.Sc II UGC) sponsored text book. ✓ Engineering Chemistry, Jain & Jain, Dhanpat Rai Publishing Co. ✓ M. M. Benjamin, D. F. Lawler, Water Quality Engineering: Physical / Chemical Treatment Processes by La - John Wiley & Sons (2013). **Suggested links for e-resources:** ✓ https://swayam.gov.in/ ✓ https://www.coursera.org/learn/physical-chemistry ✓ https://nptel.ac.in/courses/104/108/104108124/ ✓ https://nptel.ac.in/courses/104/106/104106122/

*Applicable for courses having practical component.

CC-4

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	IV		
Name of the Course	Major Industrial Chemistry-IV		
Course Code	B23-ICH-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1 Understand processing of industrial products like pulp and paper and sugar from sugar cane. 2 Prepare various organic compounds by applying the knowledge of unit processes like hydrogenation, oxidation, nitration and alkylation methods. 3 Understand various sources of water pollution and its management. 4 Understand about the solid waste management in various industries and apply the knowledge of various instruments for its analysis. 5*. Determine the viscosity, surface tension, refractive index and molar refractive index of any liquid and qualitatively analyze various chemical processing industries like petroleum, food, oils and pharmaceutical industries.		
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: 3 hrs. for Theory and 3 hrs. for Practical

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	**Pulp and Paper Industry** Introduction, methods of pulping, manufacturing of wood pulp by sulphate process, bleaching of wood pulp, refining of pulp, sizing, coloring and manufacturing of paper by fourdrinier machine. **Sugar Industry** Introduction, manufacturing and refining of sugar from sugar cane.	12 Hrs.
II	**Hydrogenation Unit Process** Introduction, types of catalysts used for hydrogenation, commercial process of hydrogenation of vegetable oil. **Alkylation Unit Process** Introduction, types of alkylation reactions, alkylating agents, manufacturing process of ethyl benzene. **Oxidation Unit Process** Introduction, types of oxidation reactions, oxidizing agents, commercial manufacturing process of benzoic acid and acetic acid. **Nitration Unit Process** Introduction, types of reaction, nitrating agents, mechanism of nitration and manufacturing process of nitrobenzene.	11 Hrs.
III	**Water pollution** Definition, sources and bad effects of water pollution, water analysis, determination of alkalinity, acidity, hardness, dissolved oxygen and chloride content.	

	Water Treatments Treatments of waste water, preliminary treatment- removal of solids, grit, oil and greases, primary treatment of water- sedimentation and flocculation, secondary treatment- filters i.e. trickling filter, tertiary treatment- chlorination and chemical treatment.	11 Hrs.
IV	**Solid Waste Management** Classification of solid waste, microbiology of solid waste, disposal processes- composting, sanitary land filling incineration and pyrolysis. **Process Instrumentation** Principle, construction and working of the following instruments - Glass thermometer, bimetallic thermometer, pressure manometer and Barometers. (11Hrs)	11 Hrs.
V*	**Practical paper: Material Analysis and Organic Synthesis** ❖ Determine the Viscosity of a given liquid by Ostwald's Viscometer. ❖ Determine the Surface tension of a given liquid by Stalagmometer. ❖ Determine the Surface tension of a given liquid in the presence of surfactant. ❖ Determination of Refractive index of a given liquid by Abbe's refractometer. ❖ Determination of Molar refractivity and specific refractivity of a liquid by using Abbe's refractometer. ❖ To prepare a pure sample of Sulphanilic acid. ❖ To prepare a pure sample of m-nitroaniline from m-dinitrobenzene. ❖ To prepare a pure sample of p-nitro benzoic acid from p-nitroaniline. ❖ To prepare 4-amino benzoic acid from 4-nitrobenzoic acid.	30 Hrs.
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➢ **Practicum (10 Marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil		**End Term Examination:** 50 Marks 20 Marks

Part C-Learning Resources
Recommended Books/e-resources/LMS: ✓ Organic Chemistry, J.G. Smith, Tata McGraw-Hill Publishing Company Limited. ✓ Guidebook to Mechanism in Organic Chemistry, P.A. Sykes, Pearson Education. ✓ Advanced Organic Chemistry, J. March, Fourth edition, Wiley. ✓ Industrial Chemistry, B.K. Sharma, GOEL, Publishing House. ✓ Handbook of Pulp and Paper technology Book on Pulp and Paper Industries, K.W. Britt, 2 Ed. ✓ Industrial Pollution and Environmental Management, R.K, Trivedy, N.S. Raman, Scientific Publishers Journals.Environmental and Pollution Science, M. Brusseau, I. Pepper, C. Gerba, Third Edition, Elsevier Science. ✓ Study material in Vocational subject of Industrial Chemistry (B.Sc. II UGC) sponsored text book. **Suggested links for e-resources:** ✓ https://swayam.gov.in/ ✓ https://www.coursera.org/learn/physical-chemistry ✓ https://nptel.ac.in/courses/104/106/104106122/

*Applicable for courses having practical component.

CC-5

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	V		
Name of the Course	Major Industrial Chemistry-V		
Course Code	B23-ICH-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1 Understand chromatography and accuracy analysis. 2 Know about modern instrumental analysis methods for qualitative measurements. 3 Get Knowlegde about spectrophotometer and refrectrometer. 4 Understand skills related to the instrumental analysis of various raw materials used in the industry for the production of various compounds. 5*. Analyze various properties by applying instruments pH meter, Refractrometer, Polarimeter, Nephelometer and Spectrophotometer.		
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: 3 hrs. for Theory and 3 hrs. for Practical**	
Part B- Contents of the Course			

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	**Chemometrics** Accuracy and precision, classification of errors and their minimization. Significant figures and computations. Standard deviation and relative standard deviation. **Chromatography** Principle and classification of chromatographic method, paper chromatography, Thin layer chromatography, HPLC and gas chromatography.	12 Hrs.
II	**Buffer solutions** Types of buffer solutions, buffer action, buffer capacity, importance of pH and its measurement. **Spectrophotometry** Principle, instrumentation for absorption measurements, qualitative and quantitative applications.	11 Hrs.
III	**Solvent Extraction** General discussion, factors favoring solvent extraction, classification of solvent extraction systems, applications of solvent extraction. **Amperometric titration** Theory, types and applications of amperometric titration. **Polarimetry** Principle, instrumentation and applications of polarimetry.	11 Hrs.
IV	**Refractometry** Principle, instruments and application of refractometry. **Nephelometry** Principle, instruments, factors affecting intensity of scattered radiations and application of nephelometry.	11 Hrs.
V*	**Practical paper : Material Analysis and Organic Synthesis** ❖ Study of λ_{max} of an absorbing sample by spectrophotometer. ❖ Determine the specific and molar rotation of an optically active substance like sucrose.	

	❖ Identification of cations in the mixture by paper chromatography. ❖ Study of number of components in the organic mixture by TLC. ❖ Separation of a mixture of organic compound by column chromatography. ❖ To determine the pH value of a given solution with pH meter. ❖ To determine the turbidity of a given solution by nephlometer. ❖ To find out the partition coefficient of iodine between CCL4 and water.	30 Hrs.

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➢ **Practicum (10 Marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil	**End Term Examination:** 50 Marks 20 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Vogel's Text book of Quatitative Chemical Analysis, G.H. Jeffery, J. Basset, J. Mendham
- ✓ Study Material in vocational subject, Industrial Chemistry (UGC Sponsored)
- ✓ Handbook of instrumental techniques for Analytical chemistry, F.A. Settle, Prentice Hall.
- ✓ Quantitative Inorganic Analysis, K. Kodama Interscience Publishers, New York.

Suggested links for e-resources:

- ✓ https://fac.ksu.edu.sa/sites/default/files/vogel_practical_organic_chemistry_5th_edition.pdf
- ✓ http://faculty.chas.uni.edu/~manfredi/860-121/ORG%20LAB%20MAN%20S08.pdf
- ✓ https://www.ipinnovative.com/media/open-access-books/Practical_Lab_Manua%20l_of_%20Pharmaceutical_Organic_Chemistry_-1_%20Low.pdf

*Applicable for courses having practical component.

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	VI		
Name of the Course	Major Industrial Chemistry-VI		
Course Code	B23-ICH-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1 Understand the skills related to pharmaceutical industry and pharmacopoeias. 2 Learn about the various pharmaceutical excipients and their specification in various dosage forms. 3 Know about the methods of evaluation of the crude drugs, packing material and liquid dosage form. 4 Learn the techniques for bulk production of analgesic, anti-inflammatory, sulpha drugs, vitamins and sedative and hypnotic drugs and fermentation technology for the synthesis of antibiotics. 5*. Upon successful completion of this lab course students should be able to know about the various pharmaceutical preparation and evaluation of the quality of various dosage forms.		
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: 3 hrs. for Theory and 3 hrs. for Practical**	

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	**Pharmacopoeias** Introduction to pharmacopoeias, contents of pharmacopoeias, Introduction to various formulations and routes of administration. Legal aspects of drugs: Important FDA schedules. **Dosage** Dosage forms and their classification on the basis of physical state with important characteristics, Solid dosages forms including tablets, capsules, powders, cachets, pills and suppositories, Liquid dosages forms including injection, aromatic water inhalations, colloidions, draughts, mixtures, irrigations, lotions, mouthwashes, nosal drops, ophthalmic drops, paints and solution tablets.	12 Hrs.
II	**Pharmaceuticals Excipients** Various types of excipients used of tablets, capsules, emulsions, suspensions, ointments, creams, pills, powders and in menophasic liquids (clears products). Need for use of excipients in pharmaceuticals. **Pharmaceuticals quality testing** sterility testing, pyrogen testing, glass testing.	11 Hrs.
III	**Synthesis of the bulk drugs** Antimicrobial agents – Isoniazid, p-amino salicylic acid. Synthesis of Antiinflammatory and analgesic compounds – Salicylic acid and its derivatives, ibuprofen. Synthesis of Vitamins – Vitamin A, Vitamin C and Vitamin B6 (Pyridoxine) Synthesis of Sulphur Drugs – Sulfonamides, sulphamethoxazole Synthesis of Hypnotics and sedatives – barbiturates, pentobarbital	11 Hrs.
IV	**Fermentation** General principle, types of fermentation processes, outline of	

	fermentation process unit, preparation of inoculum, fermentation media, recovery of products. Manufacturing processes of antibiotics. Penicillin G, Rifamycin, Tetracycline and cyanocobalamine.	11 Hrs.
V*	**Practical paper : Pharmaceutical preparation and analysis** ❖ To prepare chloroform spirit ❖ To prepare camphor water ❖ To prepare chloroform water ❖ To prepare cetrimide cream. ❖ To prepare a sample of zinc sulphate lotion. ❖ Monograph of aspirin tablet ❖ Monograph of paracetamol tablet. ❖ To estimate the amount of aspirin in a given tablet.	30 Hrs.

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory (20 Marks)** • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks	50 Marks 20 Marks
➢ **Practicum (10 Marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ L. Patrick. L. Graham, An Introduction to Medicinal Chemistry, OUP Oxford; 4th edition (2009).
- ✓ C. O. Wilson, O. Gisvold & R. F. Doerge, Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams and Wilkins; 8th edition (1982).
- ✓ W. O. Foye, T. L. Lemice and D. A. Williams Principles of Medicinal Chemistry (2019).
- ✓ D J. Abraham, M. Myers, Burger's Medicinal Chemistry, Drug Discovery and Development (1-8
- ✓ G.L. Patrick, An Introduction to Medicinal Chemistry, Oxford; Fifth edition (2013).
- ✓ John T. Arnason, Rachel Mata, John T. Romeo, Phytochemistry of Medicinal Plants, Springer (2019).
- ✓ Medicinal Chemistry – Ashutoskar (Vol – I, Vol – II)
- ✓ Study material in vocational subjects of industrial chemistry (UGC sponsored) Paper – II Pharmaceuticals.

Suggested links for e-resources:

- ✓ https://nptel.ac.in/courses/104/106/104106106/
- ✓ https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy16/
- ✓ https://nptel.ac.in/LocalChapter/statistics/2537

*Applicable for courses having practical component.