## Scheme C

# Chaudhary Ranbir Singh University, Jind

**Scheme of Examination for the Chemistry Subject in Under Graduate Programmes**

**As per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes**

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

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

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| 2 | MCC-3 | Scheme C | B-23-CHE-204 | **Physical Chemistry-I:** States Of Matter , Chemical Kinetics & Ionic Equilibrium | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | | | |
| | DSEC-1 | Scheme C | B-23-CHE-205 | **Chemistry Skill-I:** Chemistry Lab-Maintenance And Handling | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| | CC-M2 | Scheme C | B-23-CHE-105 | **Organic Chemistry-I:** Basic Concepts, Hydrocarbons, Haloalkanes and Haloarenes | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| | MDC-2 | Scheme C & D | B-23-CHE-206 | **Introductory Chemistry-II:** Indian Scientists, Matter, Soil & Fertilizers | 3 | 2 | 1 | 2 | 2 | 4 | 15 | 5 | 35 | 20 | 75 | 3 | 3 | | |
| | Internship of 4 credits of 4-6 weeks duration after 2nd semester | | | | | | | | | | | | | | | | | | |

## 2nd year

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| 3 | MCC-4 | Scheme C | B-23-CHE-304 | **Inorganic Chemistry-II:** Chemistry of s- and p-block elements | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| | MCC-5 | Scheme C | B-23-CHE-305 | **Organic Chemistry II:** Oxygen and Nitrogen containing functional groups | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |

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| | MCC-5 | Scheme C & D | B-23-CHE-204 | **Physical Chemistry-I:** States of Matter , Chemical Kinetics & Ionic Equilibrium | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | MDC-3 | Scheme C & D | B-23-CHE-306 | **Introductory Chemistry-III:** Chemistry and Social Life | 3 | 2 | 1 | 2 | 2 | 4 | 15 | 5 | 35 | 20 | 75 | 3 | 3 |
| 4 | MCC-6 | Scheme C | B-23-CHE-402 | **Physical Chemistry-II:** Thermodynamics and Colligative Properties | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | MCC-7 | Scheme C | B-23-CHE-403 | **General Chemistry-I:** General Spectroscopy | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | MCC-8 | Scheme C | B-23-CHE-404 | **General Chemistry-II:** Nuclear and Polymer Chemistry | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | DSE-1 | Scheme C | B-23-CHE-405 (E1) | **Elective Chemistry-I (Inorganic Chemistry):** Environmental Chemistry | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | | | B-23-CHE-405 (E2) | **Elective Chemistry-II (Organic Chemistry):** Organic Biomolecules | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |

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| | | B-23-CHE-405 (E3) | **Elective Chemistry-III(Physical Chemistry):** Phase Equilibria and Surface Chemistry | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | | | | | |
| | CC-M4(V) | Scheme C | **From The Available pool of Vocational courses of 4 credits of University as per NEP** | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | | | |
| | **Internship of 4 credits of 4-6 weeks duration after Fourth semester (if not done after second semester)** | | | | | | | | | | | | | | | | | | | |
| | **3rd year** | | | | | | | | | | | | | | | | | | | |
| 5 | MCC-9 | Scheme C | B-23-CHE-502 | **Inorganic Chemistry III:** Chemistry of Transition Elements & Coordination Chemistry | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | | |
| | MCC-10 | Scheme C | B-23-CHE-503 | **Organic Chemistry III:** Chemistry of Poly-nuclear Hydrocarbons & Heterocyclic Compounds | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | | |
| | DSE-2 | Scheme C | B-23-CHE-504(E4) | **Elective Chemistry-IV (Inorganic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | | |
| | | | B-23-CHE-504 (E5) | **Elective Chemistry-V (Organic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | | |

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| | | | B-23-CHE-504 (E6) | **Elective Chemistry-VI(Physical Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | DSE-3 | Scheme C | B-23-CHE-505 (E7) | **Elective Chemistry-VII (Inorganic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | | | B-23-CHE-505 (E8) | **Elective Chemistry-VIII (Organic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | | | B-23-CHE-505 (E9) | **Elective Chemistry-IX (Physical Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | CC-M5 (V) | Scheme C | **From The Available pool of Vocational courses of 4 credits of University as per NEP** | | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| 6 | MCC-11 | Scheme C | B-23-CHE-602 | **Physical Chemistry-III:** Electrochemical Cells, Chemical Kinetics & Catalysis | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |
| | | | | | | | | | | | | | | | | | | |
| | MCC-12 | Scheme C | B-23-CHE-603 | **General Chemistry-III:** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 |

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| DSC-4 | Scheme C | B-23-CHE-604 (E10) | **Elective Chemistry-X (Inorganic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | | | |
| | Scheme C | B -23-CHE-604 (E11) | **Elective Chemistry-XI (Organic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| | Scheme C | B-23-CHE-604 (E12) | **Elective Chemistry-XII (Physical Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| DSE-5 | Scheme C | B-23-CHE-605 (E13) | **Elective Chemistry-XIII (Inorganic Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| | Scheme C | B-23-CHE-605 (E14) | **Elective Chemistry-XIV (Organic Chemistry):** To be decided | | | | | | | | | | | | | | | |
| | Scheme C | B-23-CHE-605 (E15) | **Elective Chemistry-XV (Physical Chemistry):** To be decided | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |
| CC-M6 (V) | Scheme C | **From The Available pool of Vocational courses of 4 credits of University as per NEP** | | 4 | 3 | 1 | 3 | 2 | 5 | 20 | 10 | 50 | 20 | 100 | 3 | 3 | | |

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

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

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

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

1. Internal assessment(30%)shallbebroadlybasedonthefollowingdefinedcomponentsof;
   a. Class participation
   b. Seminar/Presentation/Assignment/Quiz/class test, etc.
   c. Mid Term Exam

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

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

Course type-MCC-4

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

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
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**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

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

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| ➢ Practicum | 50+20* |

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

**Course type-MCC-5**

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

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
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**Part B-Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

Course type-CC-M3

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
|---|---|

**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

**Suggested Evaluation Methods**

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

## Part C-Learning Resources

**Recommended Books/e-resources/LMS:**


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


**Additional Resources:**


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


**Applicable for courses having practical component.*

**Course type-MDC-3**

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

## Part B- Contents of the Course

**Instructions for Paper- Setter**

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

| Unit | Topics |
|---|---|
| I | **Basics of chemistry** **8 hours**<br>Periodic table, Atom and molecules, chemical bonding, properties.<br>Chemistry in Heritage: Extraction and uses of metals like iron and stone in ancient times, metals in ornaments, medicines, weapons and chemistry for preservatives, basics of preservation and few examples of preservatives. |
| II | **Chemistry in Life** **7 hours**<br>Edible and non- edible molecules, biochemistry of foods and medicine with examples: Aspirin, Paracetamol. Ibuprofen and Penicillin, Cephalosporin, Chemistry for industry: Artificial sweeteners, Soaps and detergents and cosmetics, Polymer and Plastics: Uses and environmental issues. |
| III | **Testing of Chemicals** **8 hours**<br>Flame test, solubility test, qualitative and quantitative identification of ions in natural samples like metal copper, iron and chromium ores and adulterant in foods.<br>Chemical pollution/Toxicity: Chemical source of water, air and soil pollution, biomagnification and metal toxicity with example and illustrations. monitoring of air pollution. |
| IV | **Future of Chemistry** **7 hours**<br>Basics of green chemistry, Reuse and recycling of by-products, zero waste chemistry and Alternate fuel and energy providing chemicals: biodiesel, natural gas and hydrogen. |
| V* | **30 hours**<br>1. Determine the calcium and magnesium contents in water samples using EDTA methods.<br>2. Determine the organic contents and pH of soil sample.<br>3. Estimate the food adulterants in edible items<br>4. Quantify the presence metals by flame test method<br>5. Demonstrate the exothermic and endothermic reaction in laboratory<br>6. Preparation aspirin and paracetamol as well as identify.<br>7. Demonstrate the protection of rusting of iron after surface spray coating. |

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

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

**Part C-Learning Resources**

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

Max. Marks:70+30*
Internal Assessment M

Course type-MCC-6

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
|---|---|

**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

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

## Part C-Learning Resources

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

Course type-MCC-7

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

| | |
|---|---|
| **Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20*** | **Time:03 + 03*** |

**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

**Suggested Evaluation Methods**

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

**Part C-Learning Resources**

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

Course type-MCC-8

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
|---|---|

**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

| | | |
|---|---|---|
| IV | ***Characterization of Polymers*** **12 Hours**<br>Thermal characterisation of polymer: Glass transition temperature (Tg), thermal stability and decomposition of polymers, Molecular weight of polymers (Mn, Mw, etc.) by end group analysis, viscometry, light scattering technique and osmotic pressure methods. Structural characterisation of polymers by IR and NMR spectroscopy. | |
| V* | **30 hours**<br>1. Determination of dissolved oxygen in a given sample of water.<br>2. Determination of Chemical Oxygen Demand (COD) in a given sample of water.<br>3. Determination of Biological Oxygen Demand (BOD) in a given sample of water.<br>4. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).<br>5. Estimation of total alkalinity of water samples ($CO_3^{2-}$, $HCO_3^-$) using double titration method.<br>6. Measurement of dissolved $CO_2$ in a given sample of water. | |

**Suggested Evaluation Methods**

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

## Part C-Learning Resources

Recommended Books/e-resources/LMS:


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


**Applicable for courses having practical component.*

Course type- DSE-1

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
|---|---|

**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

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

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

Course type- DSE-I

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

## Part B- Contents of the Course

**Instructions for Paper- Setter**

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

| Unit | Topics |
|---|---|
| I | *Carbohydrates* **12 Hours**<br>Classification of carbohydrates, reducing and non-reducing sugars, biological functions, general properties and reactions of glucose and fructose, their open chain structure, epimers, mutarotation and anomers, reactions of monosaccharides, determination of configuration of glucose (Fischer proof), cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosaccharides: structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. |
| II | **Amino Acids, Peptides and Proteins** **11 Hours**<br>Classification of amino acids and biological uses of amino Acids, peptides and proteins. Zwitterion structure, isoelectric point and correlation to acidity and basicity of amino acids. Determination of primary structure of peptides, determination of N-terminal amino acid (by Edman method) and C– terminal amino acid (with carboxypeptidase enzyme). Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyloxycarbonyl) & C-activating groups (only DCC) and Merrifield solid phase synthesis, Overview of primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins. |
| III | *Nucleotides* **11 Hours**<br>Sugars and bases; Conformation of sugar-phosphate backbone; hydrogen bonding by bases; the double helix; A, B, and Z double helices; Stability of Double Helix; DNA intercalators; Chemical synthesis of DNA.<br>***Lipids:*** Fatty acids, triacylglycerols, phospholipids, lipid bilayer formation, steroids (cholesterol) |
| IV | ***Enzymes and correlation with drug action:*** **11 Hours**<br>Classification of enzymes and their uses (mention Ribozymes). Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and non-competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure – activity relationships of drug molecules, binding role of –OH group, -NH2 group, double bond and aromatic ring. |

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

**Suggested Evaluation Methods**

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

**Part C-Learning Resources**

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*

Course type- DSE-1

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

| Max. Marks:70+30*<br>Internal Assessment Marks:20+10*<br>End Term Exam Marks:50+20* | Time:03 + 03* |
|---|---|

**Part B- Contents of the Course**

**Instructions for Paper- Setter**

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

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

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

**Suggested Evaluation Methods**

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

**Part C-Learning Resources**

**Recommended Books/e-resources/LMS:**


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


**Applicable for courses having practical component.*