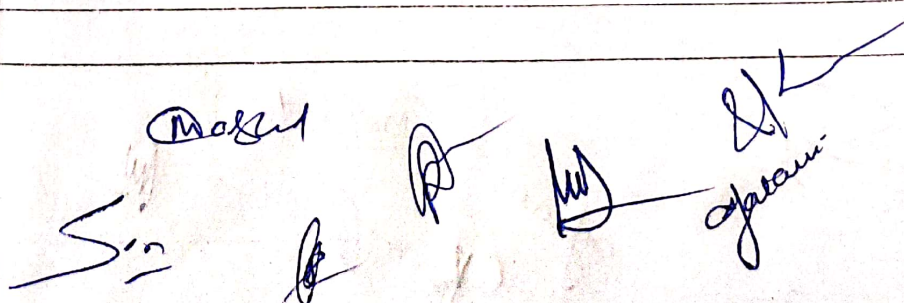


CC-5

Session 2023-24

## Part A- Introduction

Subject	Chemistry		
Semester	V		
Name of Course	Chemistry-V		
Course Code	B-23 CHE-501		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of Course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> <li>1. Enable to understand the basis of coordination chemistry of complexes.</li> <li>2. To learn about role of thermodynamics and equilibrium in predicting various physical properties of systems.</li> <li>3. Get knowledge about the quantum mechanical properties and analysis of diatomic molecules by spectroscopy.</li> <li>4. To understand the synthesis and mechanism of some organic reactions and heterocyclic compounds.</li> </ol> <hr/> <p>5*. Hand on practice in preparation of metal complexes, identification of organic and measurement of surface tension of solutions.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time: 03+03* Hours		
Part B- Contents of the Course			





**Instructions for Paper-Setter**

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

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

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IV	<p><b>Organic Synthesis via Enolates</b> Acidity of <math>\alpha</math>-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.</p> <p><b>Heterocyclic Compounds</b> 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.</p>	12
V*	<p>1. Systematic identification (detection of extra elements, Functional Groups, determination of Melting Point and preparation of atleast one solid derivative) of the following simple mono-functional organic compounds: Naphthalene, p-dichlorobenzene, m-dinitrobenzene, <math>\alpha</math> &amp; <math>\beta</math> naphthol, Oxalic acid, succinic acid, benzoic acid, phthalic acid, Benzamide, urea, thiourea, glucose, fructose and sucrose.</p> <p>2. Determine the solubility product of <math>\text{Ca(OH)}_2</math> at room temperature by titrating it against 0.5 N HCl solution volumetrically.</p> <p>3. Determine electrode potential of Zinc and Copper electrode in 0.1 M and 0.01M solution and calculate <math>E^\circ</math> value for these electrodes.</p>	30

**Suggested Evaluation Methods**

**Internal Assesment:20+10\***

> **Theory**

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

> **Practicum**

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

**End Term Examination:**

**50+20\***

**Part C- Learning Resources**

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

1. Organic Chemistry Volume III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company
4. Lee, J.D.: (2010), Concise Inorganic Chemistry, Wiley India.
5. Peter, A.; Paula, J. de. (2011), Physical Chemistry, 9th Edition, Oxford University Press.
6. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
7. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 2, 6th Edition, McGraw Hill Education.
8. Kapoor, K.L., A Textbook of Physical Chemistry, Vol 3, 5th Edition, McGraw Hill Education
9. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
10. McQuarrie, D.A. (2016), Quantum Chemistry; Viva Books.
11. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill.
12. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier
13. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson 75 Education).
14. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K. International
15. B.D. Khosla, V.C.Garg, A. Gulati. Senior Practical Physical Chemistry R. Chand & Company, New Delhi

\*Applicable for courses having Practical component

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Session 2023-24

## Part A- Introduction

Subject	Chemistry		
Semester	VI		
Name of Course	Chemistry-VI		
Course Code	B-23 CHE-601		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of Course (As per Annexure-1)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> <li>1. Enable to understand the chemistry of bioinorganic molecules.</li> <li>2. To learn about fundamentals of photochemistry and photophysical processes.</li> <li>3. To understand the concept of IR and NMR spectroscopy of organic compounds.</li> <li>4. Enable to understand the synthesis and other properties of amino acids, carbohydrates and their derivatives.</li> </ol> <p>5*. Hand on practice in preparation of organic/ inorganic compound, and determination of strength of various types of solutions using various instruments.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*	Examination Time:03+03* Hours		
<b>Part B- Contents of the Course</b>			

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### Instructions for Paper-Setter

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

Unit	Topics	Contact Hours
I	<b>Bioinorganic chemistry</b> 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 $\text{Na}^+$ , $\text{K}^+$ , $\text{Ca}^{+2}$ , $\text{Mg}^{+2}$ , $\text{Fe}^{+2}$ ions, Cooperativity effect, Bohr effect.	12
II	<b>Photochemistry</b> Interaction of radiation with matter, difference between thermal and photochemical process, Law of photochemistry: Lambert-Beer Law, Grothaus-Draper Law, Stark Einstein Law (Law of photochemical equivalence), calculation of integrated absorption coefficient from electronic spectra, oscillator strength, concept of singlet and triplet states, Jablonski diagram – depicting various process occurring in excited states including fluorescence, phosphorescence and non-radiative processes (internal conversion, intersystem crossing). Calculation of lifetime of excited states. Quantum Yield. Photosensitized reaction- energy transfer process (Simple example).	11
III	<b>IR Spectroscopy</b> Infrared (IR) absorption spectroscopy Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. <b>NMR Spectroscopy</b> Principle of nuclear magnetic resonance, the PMR spectrum, number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift, shielding and deshielding of protons, proton counting, splitting of signals and coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide and 1,1-dibromoethane.	11

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

1. Organic Chemistry Volume II & III by Mukherji, Singh, Kapoor and Dass, Published by New Age International Pvt. Ltd., New Delhi.
2. Huheey, J.E.; Keiter, E.A., Keiter, R. L.; Medhi, O.K. (2009), Inorganic Chemistry Principles of Structure and Reactivity, Pearson Education.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company
4. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
5. Pavia, D. (2015), Introduction to Spectroscopy, Fifth Edition, Cengage Learning India Pvt. Learning.
6. Ahluwalia, V.K., Parashar, R.K. (2011), Organic Reaction Mechanisms, 4th Edition, Narosa Publishing House.
7. Horspool, W.M. (1976) Aspects of Organic Photochemistry, Academic Press.
8. Singh J. Awasthi S K, Singh J. Fundamentals of Organic Chemistry. Pragati Prakashan Meerut.
9. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 3, 6th edition, McGraw Hill Education.
10. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 5, 6th Edition, McGraw Hill Education.
11. Kuashik, S., Singh, A. (2023), Biomolecules: From Genes to Proteins, First Edition, Berlin, Boston: De Gruyter.
12. DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), Principles of Food Chemistry, Fourth Edition, Springer.

\*Applicable for courses having Practical component

Maharaj  
Gyani  
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