B.Sc. 4th SEMESTER
DISCIPLINE SPECIFIC COURSE (CORE)

CH420C: CHEMISTRY **Max. Marks: 60**
Course Weightage: 04 Credit (Theory) **No. of Contact Hours: 60**

Course Objectives:
To introduce students to coordination chemistry, carbonyl group chemistry and electrochemistry and introductory quantum chemistry.

Course outcomes: The students after learning the course will be able to understand;

1. *The structure, bonding and isomerism in various types of complexes.*
2. *The preparation and chemical reactions of carbonyl compounds.*
3. *The electrochemistry of electrodes and cells.*
4. *The limitation of classical mechanics and importance of quantum mechanics.*

UNIT I: Coordination Chemistry (15 Contact hours)

Introduction, experimental verification of Werner's theory. Effective atomic number: Stability of coordination compounds (Thermodynamic and Kinetic) and the factors affecting stability. Chelate and macrocyclic effects.

Stereochemistry of coordination compounds with coordination numbers 2-6; Optical and Geometrical isomerism.

Bonding in coordination compounds: Valence bond theory, Limitations, Crystal Field theory, crystal field splitting in tetrahedral, square planar and octahedral systems. Calculation of CFSE, Factors affecting magnitude of CFSE; pairing energy and CFSE under weak and strong field ligands. Spectrochemical series. Magnetic and electronic properties of transition metal complexes. Limitations of crystal field theory.

UNIT II: Chemistry of Oxygen Bearing Compounds-II (15 Contact hours)

Aldehydes and ketones: Structure and reactivity of carbonyl group. Synthesis of aldehydes starting from acid chlorides and those of ketones from nitriles, carboxylic acids and 1, 3-dithianes. Reactions of carbonyl compounds with HCN, ROH, $NaHSO_3$, NH_2 -G derivatives. Mechanisms involved in Benzoin, Aldol/Cross Aldol, Perkin, Knoevenagel and Cannizzaro. Condensations / reactions. Clemmenson and Wolf-Kishner reductions, and Baeyer–Villegar oxidation.

Carboxylic acids and their derivatives: Mechanistic details of preparation of carboxylic acids using Grignard reagent, hydrolysis of nitriles andoxidation of alkyl benzenes. Factors affecting acid strength of carboxylic acids. Mechanisms involved in the HVZ reaction, conversion of acids to its derivatives. Relative stabilities and interconversion of acid derivatives into one another.

UNIT III: Electrochemistry (15 Contact hours)

Arrhenius theory of electrolyte dissociation and its limitations. Kohlrausch's law. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment without derivation). Transport number, definition and determination by Hittorf's and moving boundary methods. Application of conductivity measurements: determination of degree of dissociation and dissociation constants of

acids, solubility product of a sparingly soluble salt, conductometric titrations.

Electrochemical reaction and electrode potential. Nernst equation and its use for estimation of equilibrium electrode potential. Types of reversible electrodes (half-cells): metal-metal ion, gas-metal-ion, metal-insoluble salt-anion and redox electrodes. Glass electrode. Standard hydrogen electrode, Secondary reference electrodes (calomel, Ag/AgCl). Electrochemical series and its significance. Application of EMF measurements: determination of thermodynamic functions of cell reactions (ΔG, ΔH and K.), pH,pKa and solubility product. Concentration cells and its types.

UNIT IV: An introduction to Quantum Chemistry (15 Contact hours)

Limitation of Classical mechanics: Black-body radiation and Planck's radiation law, photoelectric effect, heat capacity of solids and atomic spectra.
Classical wave equation, concept of quantization in standing waves, de- Broglie equation, Schrodinger wave equation and its importance. Eigen value equation- Eigen function and Eigen values. Wave Function and its physical interpretation.
Introduction to operators, Algebra, Rules for setting operators (position and linear momentum), Hamiltonian operator. Linear and Hermitian operators, commutation of operators. Operator method for derivation of Schrodinger equation. Postulates of quantum mechanics,
Quantum mechanical treatment of particle in a one-dimensional box.

Books Recommended:

1. Coordination Chemistry; D Banerjee; 3rdEdn., Asian Books, 2009.
2. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33rdEdn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017
3. Advanced Inorganic Chemistry; S. Prakash, G.D. Tuli, S.K. Basu, R.D. Madan; 18th Revised edition, S Chand, 2000.
4. Advanced Organic Chemistry; J. Singh, L.D.S Yadav; 14thEdn., PragatiPrakashan, 2017.
5. Organic Chemistry; P.Y. Bruice; 8thEdn. Pearson Education, 2017.
6. Organic Reactions and Their Mechanisms; P.S. Kalsi; 4thEdn., New Age Int. Pvt. Ltd., 2017.
7. Advanced Organic Chemistry; J. Singh, L.D.S Yadav; 14thEdn., PragatiPrakashan, 2017.
8. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47thEdn.,Vishal Pubs & Co, 2017.
9. Atkins' Physical Chemistry; P. Atkins, J. de Paula, J. Keeler; 11thEdn. Oxford University Press, 2018.
10. Physical Chemistry; T. Engel, P. Reid,;3rdEdn., Pearson India, 2013.
11. Quantum Chemistry; D. A. McQuarrie; viva Student Edn., Viva Books, 2016.
12. Quantum Chemistry; R.K. Prasad; 4th revised Edn., New Age International, 2010.

CH420C: PRACTICALS **Max. Marks: 30**
Course Weightage: 02 Credit **No. of Contact Hours: 60**

Section A: Organic Chemistry:

Organic Preparations:

a) Dibenzal acetone from benzaldehyde.
b) Adipic acid by chromic acid oxidation of cyclohexanol.
c) Phenol formaldehyde resin.
d) Cinnamic acid by Knoevenagelcondenation.

Section B: Inorganic Chemistry:

Preparation of following coordination compounds of transition metals (Any Three)

a) Potassium trisoxalatoferrate (III)-$K_3[Fe(C_2O_4)_3]$.
b) Tetraamine Copper Sulphate $[Cu(NH_3)_4]SO_4$.
c) Potassium trisoxalatochromate (III).
d) Tristhiourea copper (I) sulphate monohydrate

Section C: Physical Chemistry

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
b) Determination of the critical solution temperature and composition of the phenol water system and study the effect of impurities on it.

Books Recommended:

1. Vogel's Qualitative Inorganic Analysis; G. Svehla; 7th Ed., Pearson Education. 2013.
2. Vogel's Textbook of Quantitative Inorganic Analysis; Bassett, G. H. Jeffery, J. Basset, J. Mendham, R. C. Denny, 6th ed., ELBS; 2007.
3. Advanced Practical Inorganic Chemistry; Gurdeep Raj; Krishna Prakashan Media (P) Ltd; 2013.
4. The Synthesis and Characterization of Inorganic compounds W. A Jolly, 3rdEdn.; 1990.
5. Synthesis and Technique in Inorganic chemistry, G. S. Girlomi; R. J. Angleci; University Science Books. 3rdEdn.; 1999.
6. Vogel's Textbook of Practical Organic Chemistry; B.S. Furniss, A.J. Hannaford, P.W.G. Smith, & A.R., Tatchell; 5th Edn., Pearson India, 2003.
7. Practical Organic Chemistry; F.G. Mann, & B.C. Saunders; Orient-Longman, 1960.
8. Laboratory Manual in Organic Chemistry; R.K. Bansal; 5th Revised Edn., Nw Age International Limited, 2008.
9. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis;V. K. Ahluwalia, R. Aggarwaal; Universities Press, India, 2000.
10. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rdEdn; Vikas Publishing, 2009.
11. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media (P) Limited, 2015.
12. Inorganic Chemistry Practical; D. Pant, Bookrix, 2010.