SEMESTER -II

INORGANIC AND ORGANIC CHEMISTRY-I

Program: B.Sc. **Max. Hours: 60**
Course Code: U20/CHE/DSC/201 **Max. Marks: 100**
Course: DSC-2 **Hours per week: 4**
No. of Credits: 4

DISCIPLINE SPECIFIC CORE 2

COURSE OBJECTIVES:

- To explain the various aspects of Chemical bonding and quantitative analysis.
- To study about the elements of p block and the properties of their compounds.
- To classify organic molecules by their functional groups and identify fundamental properties associated with those functional groups
- To learn structures of amino acids and proteins, synthesis and reactivity of amino acids.

COURSE OUTCOMES:

CO 1: Understand the concepts of chemical bonding and apply their knowledge in quantitative analysis.

CO 2: Acquire knowledge on p-block elements.

CO 3: Recognize functional groups in organic molecules and predict their reactivity through mechanisms.

CO 4: Predict the structure and chemical reactivity of amino acids.

INORGANIC CHEMISTRY

MODULE 1: CHEMICAL BONDING & THEORY OF QUANTITATIVE ANALYSIS

(15 Hrs)

CHEMICAL BONDING (10 Hrs)

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, Polarity and polarizability of ions, covalent nature of ionic bonds. Covalent bond- VB theory and common hybridization and shapes of molecules.

Molecular orbital theory- shapes and sign convention of atomic orbital, modes of overlapping, concepts of sigma and pi bonds, criteria forming molecular orbital from atomic orbital. LCAO-concept. Types of molecular orbitals, bonding and anti-bonding and non-bonding. MOED of homonuclear - H_2, N_2, O_2, O_2^-,O_2^2 F_2, (unhybridized diagram only) and heteronuclear diatomic molecules CO , CN NO, NO^+ and HF. Bond order, stability and magnetic properties.

THEORY OF QUANTITATIVE ANALYSIS (5 Hrs)

Principles of volumetric analysis: Introduction, standard solution, indicators, endpoint, titration error. Types of titrations: i) Neutralization titrations- principle, titration curves and selection of indicators- strong acid-strong base, strong-acid- weak base, weak acid-strong base, weak acid-weak base. ii) Redox titrations-principles, detection of endpoint, redox indicators. iii) Precipitation titrations-principle, detection of endpoint, indicators.
iv) Complexation titrations-principle, metal ion indicators.

Principles of gravimetric analysis – Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate. Co-precipitation and post-precipitation. Explanation with suitable examples.

MODULE 2: P-BLOCK ELEMENTS & EVALUATION OF ANALYTICAL DATA

P-BLOCK ELEMENTS (8 Hrs)

General Characteristics of p block elements.

Group – 13: Synthesis and structure of diborane and higher Boranes (B_4H_{10} and B_5H_9) Preparation and structure of boron-nitrogen compounds ($B_3N_3H_6$ and BN), Lewis acid nature of the BX_3

Group – 14: Classification (ionic, covalent, interstitial) and industrial applications of Carbides. Preparation, classification (straight chain, cyclic and cross-linked) types (oils, grease, resins, and rubber) and applications of silicones, Preparation and applications of graphitic compounds.

Group – 15: Preparation, structure and reactions of hydrazine, hydroxylamine, Phosphazenes

Group – 16: Classifications of oxides based on (i) Chemical behaviour and (ii) Oxygen content. Normal: acid, basic, amphoteric and neutral, Mixed oxides, Sub oxides, Peroxides, Super oxides.

Oxyacids of N, P, S and Cl – structure, acidic nature and redox properties

INTERHALOGENCOMPOUNDS (2 Hrs)

Classification- general preparation- structures of AB, AB_3, AB_5 and AB_7 type and reactivity. Poly halides- definition and structure of ICl_2 ICl_4^- and I_3^-.Comparison of Pseudo halogens with halogens**.**

CHEMISTRY OF ZERO GROUP ELEMENTS (2 Hrs)

General preparation, structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides. Clatherate compounds and Anomalous behaviour of He (II)**.**

EVALUATION OF ANALYTICAL DATA (3 Hrs)

Significant figures, accuracy and precision. Errors-classification of errors- determinate and indeterminate errors, absolute and relative errors, propagation of errors in mathematical operations – addition, subtraction, division and multiplication (with respect to determinate errors).

ORGANIC CHEMISTRY

MODULE 3- FUNCTIONAL GROUP ORGANIC COMPOUNDS I (15 Hrs)

HALOGEN COMPOUNDS (4 Hrs)

Nomenclature and classification: alkyl (primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl. Chemical reactivity - reduction, formation of RMgX, Nucleophilic substitution reactions – classification into S_N1 and S_N2. Mechanism and energy profile diagrams of S_N1 and S_N2 reactions. Stereochemistry of S_N2 (Walden Inversion) 2-Bromobutane, S_N1 (Racemisation) 1-Bromo-1-phenylpropane explanation of both by taking the example of optically active alkyl halide.Structure and reactivity – Ease of hydrolysis - comparison of alkyl, vinyl, allyl, aryl, and benzyl halides.

ALCOHOLS, PHENOLS AND ETHERS (6 Hrs)

Alcohols: Preparation of 1^o, 2^o and 3^o alcohols using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification (mechanism), oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation

Diols: oxidation of diols , Pinacol – Pinacolone rearrangement.

Phenols: Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, Halogenation and sulphonation. Reimer- Tiemann

Reaction (with mechanism), Gattermann Aldehyde Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction, Azo coupling reactions

Ethers (aliphatic and aromatic): Preparation: Williamson synthesis, Reaction: Cleavage of ethers with HI.

CARBONYL COMPOUNDS **(5 Hrs)**

Aldehydes and ketones: Preparation: from acid chlorides,nitriles and 1,3-dithianes. Reactions – Reaction with HCN, $NaHSO_3$, ROH– hemi acetal and acetal formation, NH_2-G derivatives- **(a)** NH_3 (b) RNH_2 (c) NH_2OH (d) $PhNHNH_2$ (e)2,4-DNP. Mechanisms of Iodoform test. Aldol Condensation, Cannizzaro's reaction,Wittig reaction, Benzoin condensation, Knoevenagel condensation, Reduction reactions(no mechanism required) Clemmensen reduction and Wolff Kishner reduction. Meerwein-Pondorff –Verley reduction. Oxidation: Baeyer – Villiger oxidation**.**

MODULE 4: FUNCTIONAL GROUP ORGANIC COMPOUNDS II **(15 Hrs)**

CARBOXYLIC ACIDS AND THEIR DERIVATIVES **(4 Hrs)**

Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters (with mechanism). Hydrolysis of Nitriles. Reactions: (no mechanism required) Hell – Volhard – Zelinsky Reaction. Degradation of carboxylic acids by HunsDiecker reaction, Schmidt reaction (decarboxylation), Arndt – Eistert synthesis

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Reformatsky Reaction (mechanism), Perkin condensation (mechanism).

AMINES (ALIPHATIC & AROMATIC) (**4 Hrs)**

Nomenclature & Classification into primary, secondary & tertiary amines & quaternary ammonium compounds. Preparation- 1. ammonolysis of alkyl halides, 2. Gabriel synthesis, 3. Hoffmann's bromamide reaction (mechanism), reduction of amides & Schmidt reaction. Physical properties & basic character – Comparative basic strengths of NH_3, CH_3NH_2, $(CH_3)_2$ NH, $(CH_3)_3N$ & Aniline- Comparative basic strengths of aniline, N-methylaniline & N,N dimethylaniline (in aqueous & non-aqueous media), steric effects & substituent effects. Use of amine salts as phase transfer catalysts. Chemical properties: a) alkylation, b) acylation c) Carbylamine reaction, d) Hinsberg separation, reaction with nitrous acid of 1°,2°,3° (aliphatic & aromatic amines) Electrophilic substitution of aromatic amines- bromination & nitration, oxidation of aryl & tertiary amines, diazotisation.

DIAZONIUM SALTS (2 Hrs)

Preparation & mechanism. Synthetic importance-replacement of diazonium group by OH, X(Cl)-Sandmeyer & gattermann reaction, by fluorine (Schiemann reaction), By iodine,CN,NO_2,H & aryl groups. Coupling reaction of diazonium salts- 1.with phenols 2.with anilines. Reduction to phenylhydrazines.

AMINO ACIDS AND PROTEINS (5 Hrs)

Classification: Amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and Leucine) by following methods: a) From halogenated Carboxylic acid b)Malonic ester synthesis c) Strecker's synthesis. Physical properties: Optical activity of naturally occurring amino acids: L – configuration, irrespective of sign of rotation. Zwitterion structure – salt like character, solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups – Lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins, peptide synthesis.

Text Books

1. Principles Of Inorganic Chemistry By Puri, Sharma And Kalia. Vishal Publications 1996.
2. Concise Inorganic Chemistry By J.D. Lee 3rd Edn.
3. Bahl, A. And Bahl, B.S. (2011). *A Textbook Of Organic Chemistry*. Ram Nagar, New Delhi: S. Chand And Company.
4. Jain, M.K., And Sharma, Sc. (2011). *Modern Organic Chemistry*. Jalandhar, Delhi: Vishal Publishing Co.
5. Basic Inorganic Chemistry By F.A. Cotton, G.Wilkinson And Paul.L. Gaus 3rd Edn.

Reference Books

1. Inorganic Chemistry By Shriver And Atkins 3rd Edn Oxford Press 1999. Inorganic Chemistry Principles Of Structure And Reactivity By James E.Huhey, E.A. Keiter And R.L. Keiter 4th Edn.
2. textbook Of Inorganic Chemistry By R Gopalan.
3. Morrison R.T., Boyd, R.N., And Bhattacharjees.K.(2011). *Organic Chemistry*. Delhi, Chennai, Chandigarh: Pearson.
4. Ferguson, L. (1966). *The Modern Structural Theory Of Organic Chemistry*. New Delhi: Prentice-Hall Of India Pvt.
5. Solomons, T., & Fryhle, C. (2008). *Organic Chemistry* (9th Edn.). Hoboken, NJ: John Wiley.
6. Sharma, Y.R. (2012). *A Text Book Of Complete Organic Chemistry*. Bangalore: Kalyani Publishers

SEMESTER-II
INORGANIC AND ORGANIC CHEMISTRY-I
THEORY

Course Code: U20/CHE/DSC/201 **Max. Marks: 60**

Credits: 4 **Max. Time: 2 Hrs**

SECTION –A

I. Answer the following **4X10=40 M**

1. Draw the Molecular Orbital Energy level diagram of CO molecule. Give the bond order and Magnetic behavior. (CO 1) 10M

OR

2. a. Explain the principle and detection of end point in redox titrations. (CO1) 5M
   b. Write short notes on acid –base indicators. (CO 1) 5M
3. a. Classify the oxides based on the oxygen content. (CO 2) 4M
   b. What are interhalogen compounds? Explain the structure of AX_5 type of molecule. (CO 2) 6M

OR

4. a. Discuss the structure of Diborane.(CO 2) 5M
   b. What are silicones? Classify them. (CO 2) 5M
5. Explain the hydrolysis of primary and tertiary alkyl halides with mechanism, stereochemistry and energy profile diagram. (CO 3) 10 M

OR

6. a. Elucidate the mechanism of Aldol condensation. (CO 3) 5M
   b. Using Grignard reagent how are Ethanol, isopropylalcohol and tertiary butylalcohol prepared. 5M

7. a. What is Esterification? Explain with mechanism. (CO 4) 5M
   b. Explain Perkin's Condensation with a suitable mechanism. (CO 4) 5M

OR

8. a. Interpret Zwitter ion nature of amino acids with suitable evidences. (CO 4) 5M
   b. Using Strecker's synthesis, how can the following amino acids be synthesized
   (i) Valine (ii) Glycine. (CO 4) 5M

SECTION –B

II. Answer any FOUR **4x5=20 M**

9. Discuss the structure of XeO_3(CO2)
10. Explain the terms co-precipitation and post precipitation (CO 1)
11. Write the preparation and structure of hydroxylamine and hydrazine. (CO2)
12. How primary, secondary and tertiary amines separated by Hinsberg test? (CO 4)
13. Explain the following. (i) Reimer Teimann reaction. (ii) Lucas test (CO 3)
14. Write a note on a) Hell – Volhard – Zelinsky b) Hun's Diecker reaction. (CO5)