BSc Semester **IV Chemistry Syllabus**

Unit-I

1. **Organometallic compounds [6 hours]**
   Introduction, Classification based on nature of M-C Bond and heptacity.
   Preparation, Properties and uses of Organo Lithium compounds and organo magnesium compounds
   Preparation, bonding & structure of : Zeise Salts, Tri Methyl aluminium (dimer), Ferrocene
2. **Bioinorganic chemistry [6 hours]**
   Metalloporphyrins, structure and roll of Hemoglobin in biological system, myoglobin, structure of chlorophyll and its importance, toxicity of arsenic, mercury, lead and cadmium, reason for toxicity.

Unit-II

3. **Noble gases [8 hours]**
   Introduction, Occurrence, Compounds of inert gas;
   Preparation, structure (VBT) and properties of XeF_2, XeF_4, XeF_6, $XeOF_4$, XeO_2F_2, $XeOF_2$, KrF_2, oxide of xenon – XeO_3, XeO_4, use of Noble gases.
4. **Active methylene compounds: [4-hours]**
   Definition, Keto-enol Tautomerism in Ethyl acetoacetate,
   Preparation of Ethyl acetoacetate [Claisen Condensation with reaction mechanism]
   Chemical Reactions of Ethyl acetoacetate: [Reduction, hydrolysis (with dil. H_2SO_4, with ethanolic KOH), with sodium ethoxide, reaction with alkylhalide, Reaction with $NaHSO_3$ and HCN, reaction with Aldehydes]
   Synthesis from Ethyl acetoacetate
   - Monocarboxylic acid: Butyric acid and Valeric acid
   - Ketone : 2-Pentanone and 3- Methyl 2-pentanone
   - α, β – unsaturated acid : Crotonic acid
   - Dicarboxylic acid: Adipic acid
   - Diketone: Acetyl acetone and Acetonyl acetone,
   - Keto acid: Levulenic acid

Unit-III

5. **Carbonyl Compounds (Aldehydes & ketones): [6-hours]**
   Structure, reactivity and Preparation of aldehydes and ketones: from acid chlorides and from nitriles.
   Reactions: Nucleophilic additions (with HCN, ROH, $NaHSO_3$), Nucleophilic addition-elimination reactions (with ammonia derivatives with mechanism), oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$,)
6. **Carboxylic Acids and their Derivatives: [6-hours]**
   Carboxylic acids:
   Acidity of Carboxylic acids, Effect of substituents on Acidity of carboxylic acids

Preparation of monocarboxylic acids (by hydrolysis of acid derivatives)
Reactions of monocarboxylic acids: Salt formation, Decarboxylation, Halogenation – Hell Volhard Zelinsky Reaction

Carboxylic acid derivatives

Preparation of Acid chlorides, Anhydrides, Esters and Amides from carboxylic acids and their inter-conversion
Mechanism of Esterification
Hydrolysis of Esters ($B_{AC}2$ Mechanism)

Unit-IV

7. **Name Reaction and Rearrangements-II: [4-hours]**

Name Reaction: Aldol condensation, Perkin Reaction, Wittig reaction
Rearrangement: Beckmann Rearrangement, Benzil-Benzilic acid Rearrangement, and Hofmann bromamide degradation.

8. **Physical Properties and Molecular Structure: (8-hours.)**

Introduction

Types of Physical Properties: Additive and Constitutive Properties
Molar Volume: Kopp's Law, Atomic Volume
Surface Tension: Explanation of Surface Tension, Name of Methods to Determine Surface Tension, The Drop Weight Method
Parachor: Macleod Equation and $P_1/P_2 = V_1/V_2$, Atomic Parachor, To Determine Structure of (i) Quinine (ii) Benzene (iii) Isocyanides group (iv) Nitro group
Viscosity: Explanation (Briefly), Unit and Factors Affecting the Viscosity, Measurement of Viscosity (Derivation of $\eta_1 / \eta_2 = d_1t_1 / d_2t_2$), Ostwald's Viscometer
Refractive Index and Refractivity: Introduction, Specific and Molecular Refractivity, Abbe Refractometer, Molecular Refractivity and Chemical Constitution
Optical Activity: Polarization of Light, Optical Activity,Factors Affecting Angle of Rotation, Specific Rotation, Polarimeter
Dipole Moment: Polar and Non-polar molecule,Electric Polarization (Polarizability of Molecules), The Mosotti Clausious Equation, Kinds of Molar Polarization [Electron & Nuclear Polarization, Orientation Polarization (Permanent Dipole Moment)]; Application of Dipole Moment: Identification of Polar and Non-polar molecules, Molecular Structure :(i) Mono atomic molecules, (ii) Diatomic molecules (iii) Triatomic molecules (CO_2, H_2O, SO_2) (iv) Tetratomic molecules (NH_3, BCl_3) (v) Aromatic Compounds (Benzene) (vi) Resonance Structure (N_2O) (vii) Cis-Trans Isomer (viii) Orientations in Organic Molecules (o, m and p substitution),
Numericals

Unit - V

9. **Thermodynamics: (12 hours)**

Introduction, Limitations and Advantages of Thermodynamics, Types of Systems

State Variables, properties of System: Extensive and Extensive Properties, Types of Processes, State and Path Functions, Exact and Inexact Differential Concept of Heat, Work and Internal Energy, First Law of Thermodynamics: Statements, Mathematical derivation, Heat absorbed at constant volume, Perpetual Machine of First Kind, Enthalpy, Heat Capacity: Its types and derivation of relation ($C_p - C_v = R$), Isothermal Reversible and Irreversible Work of Ideal Gas, Proof: $W_r > W_{irr}$, Relations between P – V, V – T and T – P for Adibatic Process, Adiabatic Reversible and Irreversible work of Ideal Gas, Joule Thomson Effect, Joule Thomson Coefficient, Joule Thomson of Ideal Gas, Zeroth Law (Only Statement and Explanation), Variation of Enthalpy with Temperature (Kirchhoff Equation), Flame and Explosion Temperature, Numericals

Reference book:

1. Quantum chemistry by A. K. Chandra
2. Basic Concept of Quantum Chemistry by R. K. Das.
3. Molecular Physical Chemistry by McQuarrie
4. UGC Inorganic Chemistry - H. C. Khera (Pragati Prakashan)
5. Principles of Inorganic chemistry – Puri, Sharma & Kalia.
6. Concise Inorganic Chemistry - J. D. Lee
7. Advanced Inorganic Chemistry- Cotton and Wilkinson
8. Basic Inorganic Chemistry - Gurdeep & Chatwal
9. Organic Chemistry (Volume I, II & III) by S.M. Mukherji, S.P. Singh and R.P. Kapoor
10. A Text Book of Organic Chemistry (II Edition) by Raj K. Bansal
11. Name Reactions in Organic Synthesis by Dr. A.R.Parikh et. al
12. Reactions and Rearrangements by Gurdeep Chatwal
13. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tli and Arun Bahl, S. Chand & Co.. New Delhi.
14. Elements of Physical Chemistry, Late B.R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
15. Principles of Physical Chemistry, Samule H. Maron and Carl F. Prutton, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
16. Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
17. Elements of Physical Chemistry, Samuel Glasstone and David Lewis, Macmillan & Co.

PAPER STYLE - THEORY

INSTRUCTIONS TO PAPER SETTERS

1. B. Sc. Chemistry Syllabus for Semester III & IV consists of **FIVE** units
2. All the units carry equal weightage (14 Marks each)
3. There must be one question from each unit.
4. Each subtopic must be given due weightage in question paper
5. 70 Marks for Semester Examination & 30 marks for Internal Examinations.
6. Time duration: 2 ½ Hours

Question 1: Answer the following (UNIT-I)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 2: Answer the following (UNIT-II)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 3: Answer the following (UNIT-III)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 4: Answer the following (UNIT-IV)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks :1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

Question 5: Answer the following (UNIT-V)

a. Four objective questions each of one Mark : 1x4 = 4
b. Answer any one out two each of two Marks : 1x2 = 2
c. Answer any one out two each of three Marks : 1x3 = 3
d. Answer any one out two each of five Marks : 1x5 = 5

Total Marks: 14

PRACTICALS

CHEMISTRY PRACTICALS SEMESTER III

1. Organic Qualitative Analysis [minimum 10]

[Minimum six bifunctional Organic Compounds should be given]

Identification of an organic compound through the functional group analysis and determination of melting point or boiling point

(Bifunctional organic compounds)

2. Organic Volumetric Estimation: [Standard solution to be given]

1. To determine the amount of $-CONH_2$ in the given Acetamide solution
2. To determine the amount of Phenol / m-cresol in the given solution
3. To determine the amount of Aniline / p-toludine in the given solution
4. To determine the amount of Ester in the given solution
5. To determine the amount of Glucose in the given solution
6. To determine the amount of –COOH in the given carboxylic acid

CHEMISTRY PRACTICALS SEMESTER IV

1. Inorganic Qualitative Analysis:

[Minimum ten inorganic mixtures should be given]

Qualitative Analysis of an inorganic mixture containing four radicals, excluding PO_4^{-3}, CrO_4^{-2}, $Cr_2O_7^{-2}$, AsO_3^{-3}, AsO_4^{-3}, BO_3^{-3} and S^{-2}

2. Physicochemical Exercise

1. To determine the specific reaction rate of the hydrolysis of methyl acetate / Ethyl acetate catalyzed by H^+ ion at room temperature.
2. To study the rate of reaction between $K_2S_2O_8$ and KI.
3. To study the rate of reaction between $KBrO_3$ and KI.
4. To determine the temperature coefficient and Energy of activation for the hydrolysis of ester at two different temperatures.
5. To determine the temperature coefficient and Energy of activation for the reaction between $K_2S_2O_8$ and KI at two different temperatures
6. To determine the rate of adsorption of the given organic acid using animal charcoal.
7. Distribution Law: To study the partition co-efficient of benzoic acid between water and benzene / kerosene and hence study the molecular condition of benzoic acid in the solution.
8. To study the partition co-efficient of acetic acid between water and chloroform and hence study the molecular condition of acetic acid in the solution.