Saurashtra University

Re-accredited by NAAC
Grade ‘A’ CGPA 3.06

BSc Semester III & IV
Chemistry Syllabus
w.e.f from June 2017
With effect from June 2017

BSc Chemistry Semester III & IV  
[2017-18]

Unit wise Distribution

<table>
<thead>
<tr>
<th>Unit</th>
<th>Subject</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-I</td>
<td>Inorganic</td>
<td>12-hours</td>
</tr>
<tr>
<td>Unit-II</td>
<td>Inorganic</td>
<td>08-hours</td>
</tr>
<tr>
<td>Unit-II</td>
<td>Organic</td>
<td>04-hours</td>
</tr>
<tr>
<td>Unit-III</td>
<td>Organic</td>
<td>12-hours</td>
</tr>
<tr>
<td>Unit-IV</td>
<td>Organic</td>
<td>04-hours</td>
</tr>
<tr>
<td>Unit-IV</td>
<td>Physical</td>
<td>08-hours</td>
</tr>
<tr>
<td>Unit-V</td>
<td>Physical</td>
<td>12-hours</td>
</tr>
</tbody>
</table>

Total: 60 hours
Unit-I
1. Wave mechanics and MO theory  [12 hours]
   Introduction of wave Mechanics, Postulates of wave Mechanics, Interpretation of \( \psi, \psi^2, \psi^* \), Derivation of Schrodinger's equation in three dimensions (Cartesian Coordination), Eigen function & Eigen value, Orthogonal & Normalized wave function and problems on it, Concept of Molecular Orbital Theory, Characteristic of Molecular Orbital, Wave function of H2+ & H2, Potential energy and Schrodinger's equation for H2+ & H2, Derivation of normalized wave function of H2+ based on M.O.T., Hybridization; Derivation coefficient of wave function of Sp, Sp2 & Sp3 Hybridization.

Unit-II
2. Chemistry of Lanthanide Elements  [8 hours]

3. Aryl halides:  [4-hours]
   Preparation (by direct halogenation, from diazonium salts), nucleophilic aromatic substitution, SNAr, Benzyne mechanism
   Other reactions of Aryl halides: Wurtz-Fitting, Fitting reaction, Ulmann reaction
   Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Unit-III
4. Alcohols, Phenols, Ethers and Epoxides:  [6-hours]
   Alcohols: Preparation: Preparation of \( 1^o, 2^o \) and \( 3^o \) alcohols: using Grignard reagent; by reduction of aldehydes, ketones, carboxylic acid and esters.
   Reactions: With sodium, HX (Lucas test), esterification and oxidation (with alkaline KMnO4, acidic dichromate, conc. HNO3)
   Diols: oxidation of diols by periodic acid and lead tetraacetate
   Phenols: (Phenol case)
   Acidity and factors affecting it;
   Reactions: Electrophilic substitution (Nitration, halogenation and sulphonation),
   Ethers: Preparation of Ethers by Williamson Synthesis
   Reactions: Substitution Reaction [Reaction with Cl2 in dark & Reaction of Cl2 in light], Reactions involving C-O bond cleavage [hydrolysis, reaction with H2SO4, cold HI & hot HI]
   Epoxides: Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4.
5. Nitrogen Containing Functional Groups:

Amines
Classification of amines (Aliphatic and Aromatic)
Basicity of amines, effect of substituent on basicity of amines
Preparation of amines (by reduction of nitro compounds, reaction of organic halides with ammonia, Hoffmann degradation of amides)
Reactions of primary alkyl & arylamines: [Reaction with acid chlorides, aryl sulphophenyl chlorides, alkylhalides, HNO₃]
Chemical reactions of Aniline: Electrophilic substitution (nitration, bromination, sulphonation), Diazotization of Aniline and reactions of Diazonium salt
Hinsberg Reaction to distinguish between Primary, Secondary and Tertiary amines
Preparation and important reactions of nitro compounds, nitriles and isonitriles

Unit-IV

6. Name Reactions and Rearrangements

Name Reaction: Reimer-Tiemann reaction, Kolbe's Schmidt reaction, Carbylamine reaction
Rearrangement: Pinacol-Pinacolone Rearrangement, Fries Rearrangement, Claisen Rearrangement

7. Phase Equilibrium:
Introduction, Criteria of phase equilibrium, Explanation of terms: Phases, Components and Degrees of freedom of a system, Gibbs Phase Rule, Limitations of Phase Rule, Phase Diagram, Phase diagrams of one-component systems (water and sulphur)
Two component systems: Condensed Phase Rule, Eutectics system (Lead-Silver) and Park method of desilverization, Congruent melting point system (Mg – Zn) and Incongruent melting point system (Na - K).

Unit - V

8. Solutions:
Introduction, Factors affecting solubility, Types of solutions, Types of liquid – liquid solutions
Numericals.
9. **Nernst Distribution Law:**

(4 hours)
Introduction, Nernst Distribution Law, Its limitations, Modified Nernst Distribution Law [Solute associate in the solvent, Solute dissociate in the solvent, Solute enters into chemical reaction with solvent]. Applications, Solvent extraction Numericals

Reference book:

1. UGC Inorganic Chemistry - H. C. Khera (Pragati Prakashan)
2. Principles of Inorganic chemistry – Puri, Sharma & Kalia
3. Concise Inorganic Chemistry - J. D. Lee
4. Advanced Inorganic Chemistry- Cotton and Wilkinson
5. Basic Inorganic Chemistry - Gurdeep & Chatwal
8. Name Reactions in Organic Synthesis by Dr. A.R. Parikh et. al
9. Reactions and Rearrangements by Gurdeep Chatwal
BSc Semester IV Chemistry Syllabus

Unit-I
1. Organometallic compounds [6 hours]
   Introduction, Classification based on nature of M-C Bond and heptacetylic.
   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 role 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 XeF₂, XeF₄, XeF₆, XeOF₄, XeO₂F₂,
   XeOF₂, KrF₂, oxide of xenon – XeO₃, XeO₄, 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. H₂SO₄, with ethanolic KOH), with sodium ethoxide, reaction with alkylhalide, Reaction with NaHSO₃ 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, NaHSO₃), Nucleophilic addition-elimination reactions (with ammonia derivatives with mechanism), oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH₄, NaBH₄)
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 (BAC2 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 $n_1 / n_2 = d_{12}^2 / d_{22}^2$), 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
   **Numericals**

Unit-V
9. Thermodynamics: (12 hours)
   **Introduction. Limitations and Advantages of Thermodynamics, Types of Systems**

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)
6. Concise Inorganic Chemistry - J. D. Lee
7. Advanced Inorganic Chemistry- Cotton and Wilkinson
8. Basic Inorganic Chemistry - Gurdeep & Chatwal
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
PAPER STYLE

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 $\text{CONH}_2$ 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 $\text{COOH}$ 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 $\text{PO}_4^{3-}$,  
   $\text{CrO}_4^{2-}$, $\text{Cr}_2\text{O}_7^{2-}$, $\text{AsO}_3^{3-}$, $\text{AsO}_4^{3-}$, $\text{BO}_3^{3-}$ and $\text{S}^{2-}$
2. Physicochemical Exercise  
   1. To determine the specific reaction rate of the hydrolysis of methyl acetate / Ethyl  
      acetate catalyzed by $\text{H}^+$ ion at room temperature.  
   2. To study the rate of reaction between $\text{K}_2\text{S}_2\text{O}_8$ and $\text{KI}$.  
   3. To study the rate of reaction between $\text{KBrO}_3$ and $\text{KI}$.  
   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 $\text{K}_2\text{S}_2\text{O}_4$ and $\text{KI}$ 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.

\[\text{Signed}\]

26/12/16