Saurashtra University
Rajkot

Re-accredited by NAAC
Grade ‘B’ CGPA 2.93

Chemistry Syllabus

B. Sc. Semester III & IV
[ CBCS ]
With effect from June 2011
Unit I : Inorganic Chemistry

   - Introduction of wave Mechanics.
   - Postulates of wave Mechanics.
   - Interpretation of $\psi$, $\psi^2$, $\psi\psi^*$.
   - Derivation of Schrodinger’s equation in three dimensions (Cartesian Coordination).
   - Eigen function & Eigen value.
   - Orthogonal & Normalised wave function and problems on it.

2. Chemistry of Lanthanide Elements.
   - Introduction.
   - Occurrence & Important ores.
   - Isolation of Lanthanide Elements from ore.
   - Electronics Configuration with necessary Explanation.
   - Oxidation State & their Stability.
   - Magnetic properties.
   - Colour ( spectral ) properties.
   - Lanthanide Contraction.
   - Misch Metal.
   - Uses of Lanthanides & their Compounds.

Unit II : Organic Chemistry

1. Aldehydes and Ketones [10 Hours]
   (A) IUPAC Nomenclature of Aldehydes and Ketones
   (B) Synthesis of Aldehydes
      - Oxidation of Primary Alcohols
      - Rosenmund Reductin
      - Gattermann Koch reaction
(C) Physical Properties of Aldehydes

(D) Chemical Properties of Aldehydes (with reaction mechanism)
- Nucleophilic addition to >C=O group
  - Reaction with HCN
  - Reaction with ROH
  - Aldol Condensation
  - Crossed Aldol Condensation
  - Benzoin Condensation
  - Perkin Reaction

(E) Synthesis of Ketones
- Oxidation of Secondary Alcohols
- Addition of Organometallic reagents to acid or acid chloride

(F) Physical Properties of Ketones

(G) Chemical Properties of Ketones (reaction mechanism)
- Nucleophilic addition to >C=O group
  - Reaction with HCN
  - Reaction with ROH
  - Knoevenagel Condensation
  - Witting reaction
  - Meerwein Ponndroff-Veley Reduction
  - Wolff Kishner Reduction
  - baeye Villiger Reaction

2. Carboxylic Acid and its derivatives

   (A) Nomenclature of mono and dicarboxylic acids

   (B) Synthesis of monocarboxylic acids
      - Oxidation of Primary alcohols
      - Hydrolysis of acid derivatives

   (C) Physical Properties of mono carboxylic acids

   (D) Acidity of Carboxylic acids

   (E) Effect of substitution on Acidity of carboxylic acids

   (F) Chemical Properties of mono carboxylic acids
      - Salt formation
      - Decarboxylation
Halogenations-Hell Volhard Zelinsky Reaction
Formation of acid derivatives-acid chloride, anhydrides, amides, esters

(G) Reaction of acid Derivatives
(H) Mechanism of Esterification
(I) Hydrolysis of Esters (BAC2 Mechanism)
(J) Trans-esterification

Unit III: Physical Chemistry

1. Basic of some physical properties [09 Hours]
   - Introduction
   - Surface tension and parachor (Drop method) & its method for determination
   - Viscosity and its method for determination
   - Refractive index and its method for determination
   - Theory of Optical activity
   - Dipole moment and its method for determination
   - Application and numericals
   - Examples

2. Phase Rule and related theory of solutions [11 Hours]
   - Statement and meaning of the term – Phase, Components, Degree of freedom
   - Explanation of phase equilibrium of one component system – Water & Sulphur system
   - Phase equilibria of two component system: Solid-liquid mixture – desilverization of lead (Pb-Ag)
   - Solid solution – compound formation with congruent melting point (Mg-Zn)
   - System of CuSO_4.5H_2O
   - Theory of liquid-liquid mixture
   - Ideal liquid mixture
   - Azeotropes
   - Lower and upper consolute temperature
   - Steam distillation
   - Short explanation of Raoults’s law, Henry’s law & Nernst’s distribution law
   - Examples
Unit IV : Industrial Chemistry

1. Fuels
   - Introduction
   - Calorific value
   - Determination of calorific value- bomb calorimeter
   - Characteristic of an idea fuel
   - Classification of fuels
   - Natural solid fuels-wood, peat, lignite and coal
   - Types of coal
   - Artificial solid Fuels Charcoal, cock, and briquettes
   - High and low Carbonisation of Coal
   - natural gaseous fuels – natural gas and biogas
   - Artificial gaseous fuels – coal gas, water gas, oil gas, Produces gas
   - Advantages and dis advantages of solid liquid and gaseous fuels

2. Synthetic drugs and dyes
   - **Drugs**
     - Introduction
     - Classification
     - Synthesis and uses of sulpha trizole (cibazole), phenacetin, paludrine, chloramphenicol, veronal
   - **Dyes**
     - Introduction
     - Classification
     - Synthesis and uses of methylorange, Diamomblack -f malachite green, Indigotin Congored, Crystal violet, Anthraquinone
Chemistry Practicals Semester III

1. **Organic Qualitative Analysis** [10 marks]

   [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:** [10 marks]

   [Standard solution to be given]

   1. To determine the amount of –CONH₂ 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

3. **Gravimetric Estimation (Any Three)** [15 marks]

   1. Estimation of Ba as BaSO₄
   2. Estimation of Fe as Fe₂O₃
   3. Estimation of Ni as Ni(DMG)₂
   4. Estimation of Al as Al₂O₃
Unit I: Inorganic Chemistry

1. Molecular Orbital Theory.
   - Concept of Molecular Orbital Theory.
   - Characteristic of Molecular Orbital.
   - Wave function of $H_2^+ \& H_2$.
   - Potential energy and Schrodinger’s equation for $H_2^+ \& H_2$.
   - Derivation of normalized wave function of $H_2^+$ based on M.O.T.
   - Hybridization; Derivation co efficient of wave function of $Sp, Sp^2 \& Sp^3$
   - Hybridisation.

2. Organic Metallic Compounds.
   - Introduction.
   - Classification based on nature of M-C Bond.
   - Preparation, Properties and uses of Organo Lithium.
   - Preparation of Organo Beryllium, Organo Aluminium and Zaise Salts.
   - Structure of
     - (1) Tri Methyl aluminium (Dimer).
     - (2) Zaise Salt [PtCl$_2$-C$_2$H$_4$].
     - (3) Ferrocene.

Unit II: Organic Chemistry

1. Heterocyclic Compounds [10 Hours]
   (a) Structure and Aromaticity of Furan, Thiophene and pyrrole
   (b) Preparation of Furan, Thiophene and pyrole
   (c) Chemical Properties of Furan, Thiophene and pyrrole
      - Nitration
      - Sulphonation
      - Acetylation
      - Chlorination
      - Reaction with Organometallic Compounds
(d) Structure and Aromaticity of Pyridine
(e) Basicity of Pyridine
(f) Relative basicity of Pyridine, Pyrrole and Aliphatic amines
(g) Preparation of Pyridine from acetylene, hantzsch/s method
(h) Chemical Properties of Pyridine
   ➢ Electrophilic Substitution Reaction
   ➢ Nucleophilic Substitution Reaction

2. Active Methylene Compounds  [10 Hours]

(a) Definition
(b) Keto-enol Tautomerism in Ethyl acetoacetate
(c) Proof for structure of Ethyl acetoacetate [ Frankland – Duppa Structure & Geuther Structure]
(d) Proof for structure of Ethyl acetoacetate [ Claisen Condensation with reaction mechanism]
(e) Physical Properties of Ethyl acetoacetate
(f) Chemical Properties of Ethyl acetoacetate
   Synthesis from Ethyl acetoacetate
   ➢ Monocarboxylic acid : Butric acid and Valeric acid
   ➢ Ketone : 2-Pentanone and 3-Methyle 2-pentanone
   ➢ &b – unsaturated acid: Crotonic acid
   ➢ Dicarboxylic acid : Adipic acid
   ➢ Diketone : Acetyl acetone and Acetonyl acetone,
   ➢ Keto acid : Levulenic acid
   ➢ Hetrocyclic Compounds : 4- methyl uracil and 2,5-dimethyl pyrrole]

Unit III : Physical Chemistry

1. Chemical kinetics  [10 Hours]
   ➢ Introduction
   ➢ Order and molecularity of a reaction
   ➢ Zero order reaction
   ➢ First order reaction & it’s characteristics
   ➢ Second order reaction & it’s characteristics
   ➢ Third order reaction & it’s characteristics
- Pseudo unimolecular reaction
- Method for determining the order of reaction. (I) Graphical method (II) Ostwald’s isolation method (III) Method of half-life period (V) Integration method
- Theories of reaction rates. (I) Collision theory (II) The transition state theory
- Influence of temperature on reaction rates
- Energy of activation
- Examples

2. **The colloidal state**

   [10 Hours]
   - Introduction
   - Classification of colloidal solutions
   - Characteristics of hydrophilic and hydrophobic sols
   - Preparation of colloidal solution: Lyophilic & Lyophobic solution
   - Preparation methods: (I) Condensation methods such as by Double decomposition, Hydrolysis, Reduction, Oxidation, Exchange of solvent, controlled condensation, change of physical state in short. (II) Dispersion methods such as Bredig’s method, by Grinding, Peptization in short.
   - Purification of colloidal solution: (I) Dialysis (II) Ultrafiltration (III) Ultracentrifuging
   - Properties of colloidal solutions: (I) Optical properties such as Tyndall effect, Brownian effect, Colour (II) Electrical properties such as Electrical Charge, Electrical double layer & Zeta potential, Cataphoresis, Electro-osmosis.
   - The Protective colloid (gold number)
   - Application of colloidal state in short.

**Unit IV: Industrial Chemistry**

1. **Ceramics and Refractories**
   - Introduction To Ceramics
   - Raw materials
   - Classification based on reduction in Proosity
   - Manufacturing
   - Body Preparation using clay slip
   - Introduction to Refractories
   - Classification of Refractories
2. Synthetic Polymers

- Introduction
- Classification of Polymers.
- Classification of Polymers when based upon Intermolecular interaction
- Classification of Polymers based upon Structure
- Type of Polymerisation reaction
- Addition Polymerisation
- Free Radial Polymerisation
- Ionic Polymerisation
- Ziegler- Nutta Polymerisation
- Stereo Chemistry of Polymer Plastic
- Types of Plastics, Thermo Plastic, thermo setting Plaster
- Synthesis of Backelite, Teflon malamine, formaldehyde Polycloroprene

**Chemistry Practicals Semester IV**

1. **Inorganic Qualitative Analysis:** [20 Marks]

   [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** [15 Marks]

   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 KI.
   3. To study the rate of reaction between $\text{KBrO}_3$ and KI.
   4. To determine the relative strength of HCl and $\text{H}_2\text{SO}_4$. 
5. To determine the temperature coefficient and Energy of activation for the hydrolysis of ester at two different temperatures.

6. To determine the temperature coefficient and Energy of activation for the reaction between K₂S₂O₈ and KI at two different temperatures.

7. To determine the rate of adsorption of the given organic acid using animal charcoal.

8. 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.

9. 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.

REFERENCES BOOKS [Sem. III & IV] :-

1. Valency & Molecular Structure by Cartmell-Fowles.
7. Advanced Organic Chemistry by Arun Bahl and B.S.Bahl
8. Text Book of Organic Chemistry for BSc students by B.S. Bahl
9. Organic Chemistry by Morrison and Boyd
12. March’s Advanced Organic Chemistry Reactions, Mechanism and Structure by Michael B Smith and Jerry March
13. Reaction Mechanisms and Reagents in Organic Chemistry by Gurudeep R. Chatwal
14. Advanced Organic Reaction Mechanism by N. Tewari
15. Organic Chemistry by I.L. Finar
17. Physical Chemistry by Dr. D.R. Pandit, A.R. Rao and Padke
18. A Textbook of physical chemistry by Samuel Glasstone
19. A Textbook of physical chemistry by B.K. Sharma
20. Industrial instrumentation by Eckman. Donald P.
21. Shreeve’s Chemical Process by Austin George
22. Fuel and combustion by Sarkar & Samir