

**Rayat Shikshan Sanstha's**  
**Yashavantrao Chavan Institute of Science, Satara**  
**(Autonomous)**

**Syllabus for Bachelor of Science Part – II (B.Sc. II Chemistry)**

1. TITLE: B.Sc. Chemistry
2. YEAR OF IMPLEMENTATION: 2019-2020
3. PREAMBLE:

This updated syllabus is prepared for second year undergraduate students, to develop their interest towards chemistry and prepare them for the academic and industrial exposure simultaneously. Introduction of instrumental techniques with the regular chemistry exercises will help to enhance analytical thinking of the students. The interdisciplinary approach with vigour and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance.

4. GENERAL OBJECTIVES OF THE COURSE:

1. The content of the syllabus have been framed as per the UGC norms.
2. The students are expected to understand the fundamentals, principles, mathematical concepts and recent developments in the subject area.
3. The practical course is in relevance to the theory courses to improve the understanding of the concepts.

5. DURATION: one year

6. PATTERN: Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

1) THIRD SEMESTER ----- (NO. OF PAPERS 2)

Paper V: Organic Chemistry (BCT 301)

Paper VI: Analytical and Industrial Chemistry (BCT 302)

Practical I: (BCP 303) (Practical examination is semester wise)

2) FOURTH SEMESTER ----- (NO. OF PAPERS 2)

Paper VII: Physical Chemistry (BCT 401)

Paper VIII: Inorganic Chemistry (BCT 402)

Practical II: (BCP 403)(Practical examination is semester wise )

2) Structure and Titles of Papers of B.Sc. Course:

3) OTHER FEATURES:

A) LIBRARY: Reference and Textbooks, Journals and Periodicals, Reference Books for Advanced Books for chemistry Advanced studies. –List Attached

B) SPECIFIC EQUIPMENTS: Necessary to run the Course, Computer, LCD, Projector, Visualizer, Smart board

C) LABORATORY EQUIPMENT'S: Apparatus, equipment's and chemicals required.

**B.Sc. II Semester III**  
**Paper V Organic Chemistry (BCT 301)**

Marks: 40

| Subject                  | Unit No. | Title  | Periods   | Credits  |
|--------------------------|----------|--|-----------|----------|
| <b>Organic Chemistry</b> | I        | A) Amines and Diazonium Salts<br>B) Heterocyclic Compounds | <b>11</b> | <b>2</b> |
|                          | II       | Carbohydrates  | <b>10</b> |          |
|                          | III      | Amino acid, protein and Nucleic acid                       | <b>10</b> |          |
|                          | IV       | Organic Name Reactions and Reagents                        | <b>09</b> |          |
|                          | V        | Stereochemistry  | <b>05</b> |          |
| Grand total              |          |  | <b>45</b> |          |

**Paper VI: Analytical and Industrial Chemistry (BCT 302)**

Marks: 40

| Subject                     | Unit No. | Title   | Periods   | Credits  |
|-----------------------------|----------|---|-----------|----------|
| <b>Analytical Chemistry</b> | I        | Optical methods of analysis                                 | <b>08</b> | <b>2</b> |
|                             | II       | Electro analytical methods                                  | <b>15</b> |          |
|                             | III      | Qualitative Analysis  | <b>08</b> |          |
|                             | IV       | Gravimetric analysis  | <b>05</b> |          |
|                             | V        | Basic concept in industrial chemistry<br>Soap and detergent | <b>09</b> |          |
| Grand Total                 |          |   | <b>45</b> |          |

**Semester IV****Paper VII- Physical chemistry (BCT 401)****Marks: 40**

| <b>Subject</b>            | <b>Unit No.</b> | <b>Title</b>   | <b>Periods</b> | <b>Credits</b> |
|---------------------------|-----------------|--|----------------|----------------|
| <b>Physical Chemistry</b> | I               | Electrochemistry part I: Electrolytic Conductance and Transference | <b>12</b>      | <b>2</b>       |
|                           | II              | Electrochemistry part II: Electromotive Force                      | <b>12</b>      |                |
|                           | III             | Phase Equilibrium  | <b>08</b>      |                |
|                           | IV              | Solutions  | <b>07</b>      |                |
|                           | V               | Physical properties of liquids                                     | <b>06</b>      |                |
| <b>Grand Total</b>        |                 |  | <b>45</b>      |                |

**Paper VIII- Inorganic chemistry (BCT 402)****Marks: 40**

| <b>Subject</b>             | <b>Unit No.</b> | <b>Title</b>  | <b>Periods</b> | <b>Credits</b> |
|----------------------------|-----------------|---|----------------|----------------|
| <b>Inorganic Chemistry</b> | I               | Chemistry of elements of first transition series.               | <b>06</b>      | <b>2</b>       |
|                            | II              | Study of f- block elements                                      | <b>10</b>      |                |
|                            | III             | Co-ordination chemistry   | <b>14</b>      |                |
|                            | IV              | Bio Inorganic Chemistry   | <b>06</b>      |                |
|                            | V               | A) Chelation<br>B) Corrosion and passivity and its applications | <b>09</b>      |                |
| <b>Grand Total</b>         |                 |   | <b>45</b>      |                |

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**Syllabus Introduced from June, 2019**

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**B.Sc. Part II: Chemistry**

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**Semester III**

**Theory: Paper V: Organic Chemistry**

**Paper Code: BCT 301**

**Marks: 40**

**Credits: 2**

**Learning Objectives:**

1. To enable the students to learn the concepts of synthetic organic chemistry
2. To make student familiar about reaction mechanism, heterocyclic chemistry
3. To understand basics in reactions of amino acids, proteins etc.
4. To get basic knowledge about dye industry.

**Unit I: A) Amine and Diazonium Salt (06L)**

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO<sub>2</sub>, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

**B) Heterocyclic Compound (05L)**

Introduction, Classification, Pyrrole - method of synthesis, aromatic character, molecular orbital structure, resonance, reactivity, electrophilic substitution with mechanism, chemical reaction-reduction Nitration, sulphonation, Halogenation, Friedel-Craft reaction, coupling reaction. Comparative study of pyrrole, furan and thiophene.

**Unit II: Carbohydrates (10L)**

Classification based on chemical constitution with suitable example- Sources – open chain and ring structure of carbohydrate containing five and six carbon atom, determination of configuration of glucose and fructose, Mutarotation, reaction of glucose and fructose, acetylation, osazone, methylation, reduction and oxidation, chain lengthening and shortening reaction.

### **Unit III: Amino acid, Protein and Nucleic acid (10L)**

General structure of  $\alpha$  amino acid, isoelectric point, synthesis of an amino acid amination of halo acid, azalactone, Curtius method, Gabriel method.

Synthesis of polypeptide - Bergmann method, Fischer method, solid phase synthesis, structure of protein Nucleic acid – Classification, structure of nucleosides & nucleotides.

### **Unit IV: Organic Name Reactions and Synthetic Reagents (09L)**

Perkin reaction, Reformatsky Reaction, Knoevenagel Condensation, Claisen condensation, Mannich Reaction, Pinacole – Pinacolone Reaction, Clemmensen Reduction, Reimer – Tiemann reaction. Synthetic Reagent- Aceto Acetic ester (Ethyl aceto acetate) and Grignard Reagent

### **Unit V: Stereochemistry (05L)**

Nomenclature of Conformational isomers, Conformational analysis of Ethane and Butane, threo and erythro isomerism

### **Learning Outcomes:**

1. Recapitulate the knowledge about amine, diazonium salts and heterocyclic compound.
2. Study of glucose and fructose.
3. Introduction reaction and synthesis of amino acid, nucleic acid and protein.
4. Studies application of various name reactions
5. Studies nomenclature of conformational isomers

### **Reference Books: -**

- 1) Chemistry for Degree student by R.L. Madan. Unit-I,II,III.
- 2) Organic chemistry by T.W. Graham Solman & Craig B. Fryhle – 9<sup>th</sup> Edition. Unit-I,II,III.
- 3) Organic Chemistry by Morrison & Boyd – 6<sup>th</sup> Edition. Unit-I,II,III,V,.
- 4) Organic Chemistry by Clayden, Greeves & Warren – 2<sup>nd</sup> Edition. Unit-I
- 5) Organic reaction mechanism - V. K. Ahluwalia, Rakesh Paruskar – 4<sup>th</sup> Edition. Unit-IV

6) Stereochemistry - P.S. Kalsi, D.Nasipuri, elien. Unit-V.

7) Stereochemistry of organic compounds – Elile. Unit-V.

8) Stereochemistry – Nasipuri. Unit-V.

## **Paper VI: Analytical and Industrial Chemistry**

**Paper Code: BCT 302**

**Marks: 40**

**Credits: 2**

### **Learning Objectives:**

1. Development of analytical skills of the students.
2. To inspire and boost interest of the students towards chemistry as the main subject.
3. To inspire and boost interest of the students towards chemistry as the main subject.
4. To develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation.
5. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.

### **Unit I: Optical methods of analysis**

**[08L]**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

*UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument

*Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

### **Unit II: Electro analytical methods**

**[15L]**

Classification of electro analytical methods, Basic principle of i) pH metric, ii) Potentiometric and iii) Conductometric titrations. Techniques used for the determination of equivalence points.

Techniques used for the determination of pK<sub>a</sub> values.

#### **Potentiometric titrations**

Introduction, Instrumentation, Types of potentiometric Titrations, Advantages of Potentiometric Titrations

#### **Conductometric Titrations**

Introduction, Instrumentation ( conductance measurement- Direct reading conductivity bridge, conductivity cell and cell constant), Types of conductometric Titrations, Advantages and disadvantages of conductometric Titrations.

### **Unit III: Qualitative Analysis**

**[08L]**

Principal of qualitative and quantitative analysis, Classification of organic and inorganic qualitative analysis, Identification of compounds, the functional group analysis, Application of solubility product and common ion effect, separation of cation into groups, Application of complex formation, Application of oxidation – reduction in inorganic qualitative analysis, Choice of groups reagents & Group analysis. Interfering anions (Fluoride, borate, oxalate & phosphate),

### **Unit IV: Gravimetric analysis**

**(05L)**

i) Definition & types of gravimetric analysis ii) Precipitation technique with respect to theory iii) Solubility consideration ; Common ion effect; diverse ion effect; pH; Temperature and nature of solubility. iv) Digestion v) Nucleation vi) Co & post precipitation vii) Filtration & washing viii) Drying & Ignition.

### **Unit V: a) Basic concept in Industrial chemistry**

**(05 L)**

Unit operation - Filtration, centrifugation, floatation, Evaporation, crystallisation, Adsorption, Unit processes- Reduction, sulphonation, halogenations, nitration, polymerisation

#### **b) Soap and detergents**

**(04 L)**

Introduction, soap, manufacture of soap, Detergent or syndets, comparison between soap and detergents.

### **Learning Outcomes:**

1. Understand basic terms related to spectrophotometer.
2. Learns electroanalytical methods and its principle
3. Students learn about the basic terms use in qualitative and quantitative analysis.
4. Learns about importance of common ion effect, diverse ion effect, pH.
5. To study the manufacture of soap.

### **Reference Books:**

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative*



- Chemical Analysis*, John Wiley & Sons, 1989. Unit-V
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988. 27. Unit-II,III.
  - Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004. Unit-I
  - Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
  - Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009. Additional Reading. Unit-V,IV
  - Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed. Unit-I
  - Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elsevier Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979. Unit- I
  - Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.
  - Shreves chemical processes industries. Unit-V
  - Industrial chemistry by B.K.Sharma. Unit-V
  - J.Mendham, Vogel's A Text books of Quantitative Chemical Analysis. Unit-V
  - Walter.E.Haris, An Introduction to Chemical Analysis. Unit-V
  - Douglas A. Skoog, Fundamentals of Analytical Chemistry. Unit-V, V(a)
  - G.Svehla, Vogel's Qualitative Inorganic Analysis, Pearson. Unit- IV
  - R. M. Verma, Analytical Chemistry Theory & Practice. Unit-IV
  - W. Bernagrd King, Experiments in General Chemistry. Unit-IV

## **Practical Course: BCP: 303**

### **Learning Objectives:**

- To study the analytical technique for structure determination of organic compound. .
- To find the amount of different compound.
- To study chromatographic techniques for separation and purification of compound.
- To analyse the compounds by using different instrumental methods.

### **1) Organic qualitative analysis: (Minimum 8 compounds)**

Acids: Salicylic acid, phthalic acid, aspirin, cinnamic acid, Succinic acid, Oxalic acid,

Phenol:  $\beta$  naphthol, P Nitro phenol, M Nitro phenol.

Base: P nitro aniline, O Nitro aniline, M Nitro aniline, diphenyl amine.

Neutrals: Acetamide, ethyl methyl Ketone, Acetophenone, Benzophenone, Benzaldehyde,

methyl acetate, Chloro benzene, bromo benzene, Nitrobenzene, M- dinitrobenzene, naphthalene, thiourea.

**2) Organic Estimation:**

- a) Estimation of Acetone
- b) Estimation of glycine
- c) Estimation of Vitamin C

**3) Organic Preparations: (any three)**

- a) Preparation of Benzoic acid
- b) Preparation of P – nitro acetanilide
- c) Preparation of Benzamide
- d) Preparation of Dihydropyrimidone
- e) Preparation of Dibenzalacetone (Green synthesis)

**4) Colorimetry:**

- a) Determination of unknown concentration of potassium permanganate solution.

**5) Conductometry:**

- a) Determination of strength of strong acid by titrating against strong alkali

**6) PH Metry:**

- a) Determination of PH of given soil samples
- 7) Determination of percentage purity of boric acid using supplied sodium hydroxide
- 8) Determination of titrable acidity in the given sample of milk or lassi of alkali content of antacid tablet using HCl
- 9) Determination of percentage of nitrogen present in the given sample of nitrogenous fertilizer
- 10) Preparation of azo dye
- 12) Estimation of ester
- 12) Determination COD in water samples

**Learning Outcomes:**

- 1. Students learn qualitative analysis of organic compounds
- 2. Students Learn to standardise and to estimate quantity of acetone, glycine etc
- 3. Determines normality by titrations of strong acid Vs strong base
- 4. Students learn organic preparation and practical yield .Calculations of various organic compounds

### **Practical references:**

1. Vogel's text book of Qualitative Chemical Analysis (Longman ELBS Edition)
2. Basic concepts in Analytical chemistry by S.M.Khopkar
3. Advanced experimental Chemistry Vol. I. Physical by J. N.Gurtu&R. Kapoor. (*S. Chand &Co.*)
4. Systematic Experimental Physical Chemistry – by S. W. Rajbhoj, Chondhekar. (*Anjali Publ.*)
5. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S.P. Turakhia.  
(*Himalaya Publishing House, Mumbai.*)

## **Semester –IV**

### **Paper VII: Physical Chemistry**

#### **Paper Code: BCT 401**

**Marks: 40**

**Credits: 2**

### **Learning Objectives:**

1. To educate students with the basic concepts of physical Chemistry
2. To enhance the problem solving skills and make them familiar with simple calculations in chemistry.
3. To skill the students about theoretical principals behind practical knowledge
4. To enhance student sense of enthusiasm for chemistry and to involve them in an intellectually stimulating experience of learning in a supportive environment.

### **Unit I: Electrochemistry part I:**

#### **Electrolytic Conductance and Transference**

**[12L]**

1.1: Electrolysis and Faraday's laws of Electrolysis, Conduction of electricity,

Types of conductors: Electronic and Electrolytic.

1.2: Explanation of the terms: Specific, equivalent and molar conductance, relation between specific and equivalent conductance, variation of conductance with dilution, equivalent conductance at infinite dilution.

1.3: Migration of ions, Hittorf's rule, Transport number, Determination of transport number by Moving boundary method, Factors influencing transport number: Nature of electrolyte,

Concentration, Temperature, Complex formation, Abnormal transport number, Degree of hydration

1.4: Kohlrausch law and application of conductance measurement:

- (i) Relationship between ionic conductance, ionic mobility and transport number.
  - (ii) Determination of equivalent / molar conductance at infinite dilution for weak electrolytes.
  - (iii) Determination of degree of dissociation.
  - (iv) Determination of ionic product of water.
  - (v) Determination of solubility and solubility product of sparingly soluble salts.
  - (vi) Determination of hydrolysis constant of salt
- 1.5: Numerical problems.

## **Unit II: Electrochemistry part II: Electromotive Force** **[12L]**

- 2.1: Galvanic cells.
- 2.2: Concept of EMF of a cell. Measurement of EMF of a cell. Standard electrode potential
- 2.3: Nernst equation and its importance.
- 2.4: Types of electrodes: Metal-Metal ion electrode, Amalgam electrode, Gas electrode, Metal insoluble salt electrode, Oxidation-reduction electrode,
- 2.5: Thermodynamics of a reversible cell, calculation of thermodynamic properties:  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  from EMF data.
- 2.6: Calculation of equilibrium constant from EMF data.
- 2.7: pH determination using hydrogen electrode and quinhydrone electrode.
- 2.8: Numerical problems.

## **Unit III: Phase Equilibrium** **[08L]**

- 3.1: Phases, components and degrees of freedom of a system, criteria of phase equilibrium.
- 3.2: Gibbs Phase Rule and its thermodynamic derivation.
- 3.3: Phase diagrams of one-component systems (water and sulphur)
- 3.4: Two component systems involving eutectics, congruent and incongruent melting points (lead-silver,  $\text{FeCl}_3\text{-H}_2\text{O}$ ).
- 3.5: Derivation of Clapeyron and Clausius – Clapeyron equation and its importance in phase equilibria.

## **Unit IV: Solutions** **[7L]**

- 4.1: Thermodynamics of ideal solutions: Ideal solutions, Non-ideal solutions
- 4.2: Raoult's law, deviations from Raoult's law.
- 4.3: Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule, Azeotropes.

## Unit V: Physical properties of liquid

4.4: Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids.

4.5: Immiscibility of liquids- Principle of steam distillation.

4.6: Nernst distribution law and its applications, solvent extraction(Derivation)

### V) Physical properties of liquids

[6L]

5.1: Classification of physical properties.

5.2: Viscosity, coefficient of viscosity, determination of viscosity by Ostwald's Viscometer.

5.3: Refractive index, measurement of refractive index by Abbe's refractometer, specific and molecular refraction, molecular refractivity.

5.4: Numerical problems.

### Learning Outcomes:

1. Recapitulation of the knowledge about Electrochemistry and conductance measurement
2. Understanding basic terms related to Phase rule and solutions and derivation of equations
3. Learns the physical properties of liquids and structure elucidation
4. Derivation of relation between various types of conductance, ionic mobility and understands Kohlrausch law and solve numerical
5. Revision of the concept about galvanic cells, construct and derives equation for emf of cells

### References:

1. Principles of Chemistry by Puri and Sharma (Vishal Publishing Company, 4<sup>th</sup> edition). Unit-I,II,III,IV
2. Essentials of Physical Chemistry by B. S. Bahl and G. D. Tuli. (S.Chand.). Unit-I,II,III,IV
3. Text Book of Physical Chemistry by Soni-Dharmarha. Unit-I,IV.

#### Additional Reading:

1. Physical Chemistry by R. A. Alberty (Wiley Eastern Ltd.)
2. University General Chemistry by C. N. R. Rao (Mac-Millan.)
3. Elements of Physical Chemistry by P. W. Atkins. (Oxford University Press.)
4. Physical Chemistry through problems by S. K. Dogra, D. Dogra (Wiley Eastern Ltd.)
5. Physical Chemistry by A. J. Mee. ELBS & Heinemann Educational Books Ltd.)

6. A Text Book Physical Chemistry by S. Glasstone, (Mac Millan.)
7. Advanced Chemistry by Philip Mathews, (Cambridge University.)
8. An introduction to electrochemistry by S. Glasstone. (Mac Millan.)
9. A Text Book of physical Chemistry , by A.S.Negi and S.C. Anand, New Age International publ, 2<sup>nd</sup> Ed.
10. Advanced Physical Chemistry By Gurdeep Raj
11. Text Book Of Physical Chemistry by K.L. Kapoor

## **Paper VIII: Inorganic Chemistry**

### **Paper Code: BCT 402**

**Marks: 40**

**Credits: 2**

#### **Learning Objectives:**

1. To develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation
2. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
3. To develop the knowledge about Periodic Table among the students.
4. To make students familiar with importance of elements in biological process.

#### **Unit I: Chemistry of elements of first transition series.**

**(06 L)**

Position of elements in periodic table

Characteristics of d-block elements with special reference to i) Electronic structure

ii) Oxidation states, stability of oxidation states of Fe with respect to Latimer diagram

iii) Magnetic character iv) Colored ions v) Complex formation.

#### **Unit II: Study of f- block elements.**

**(10L)**

a) Lanthanides.

Introduction of f-block elements, Positions of Lanthanides in the Periodic Table, Electronics Configurations, Lanthanide contraction, Oxidation states,

Magnetic properties, Occurrence, Separation of lanthanides by Ion exchange method.

b) Actinides.

Position in periodic table, Electronic configuration, Oxidation States.

General methods of preparation of Transuranic elements. i) Neutron capture – followed by  $\beta$  decay. ii) Accelerated projectile bombardment. iii) Heavy ion bombardment.

**Unit III: Co-ordination chemistry (14L)**

Introduction-Definition and formation of co-ordinate covalent bond in  $\text{BF}_3 \cdot \text{NH}_3$ ,  $[\text{NH}_4]^+$  and  $\text{H}_2\text{O}$ . Distinguish between double salt and complex salt, Werner's theory-Postulates. The theory as applied to cobalt amines viz.  $\text{CoCl}_3 \cdot 6\text{NH}_3$ ,  $\text{CoCl}_3 \cdot 5\text{NH}_3$ ,  $\text{CoCl}_3 \cdot 4\text{NH}_3$ ,  $\text{CoCl}_3 \cdot 3\text{NH}_3$ . Description of the terms- ligand, co-ordination number, co-ordination sphere, Effective atomic number IUPAC nomenclature of coordination compounds. Isomerism in complexes with C.N. 4 and 6 Geometrical Isomerism, Optical Isomerism, Structural Isomerism-Ionisation Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism Valence bond theory of transition metal complex with respect to, C.N. 4, complexes of Cu and Ni C.N. 6 complexes of Fe and Co Crystal field splitting of 'd' orbital in octahedral, tetrahedral & square planar complexes. Factors affecting to the Crystal field parameters, High spin & low spin octahedral complexes of Co(II), Crystal field stabilization energy (CFSE), Limitations of CFT.

**Unit IV: Bio Inorganic Chemistry (06L)**

Introduction, Essential and trace elements in biological process, Metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to  $\text{Na}^+$  &  $\text{K}^+$ .

**Unit V: A) Chelation (05L)**

A brief introduction with respect to ligands, chelating agent, chelation and metal chelates. Structural requirements of chelate formation, Difference between metal chelate and metal complex Classification of chelating agents (with specific illustration of bidentate chelating agents) Application of chelation with respect to chelating agents - EDTA and DMG

**B) Corrosion, Passivity and its application (04L)**

Introduction of corrosion, Electrochemical theory of Corrosion, Factors affecting on corrosion, Methods of protection of metals from corrosion, Passivity: Definition, types of passivity, oxide film theory and evidences, application of passivity.

### Learning Outcomes:

1. Learns about periodic table thoroughly and understands the meaning of transition.
2. Understands the characteristics properties w.r.t. electronic configuration, lanthanide contraction, oxidation state.
3. Understands what co-ordinate bond, double salts and complex salt is.
4. Understand about the Metallo porphyrins with special reference to haemoglobin and myoglobin.
5. Students must understand the process of Corrosion, Passivity and its application

### Reference Books:

1. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985). Unit-I,II
2. Cotton, F.A.& Wilkinson, G. *Basic Inorganic Chemistry*, Wiley. Unit-I,II,III,IV
3. Puri, Sharma, Kalia. *Inorganic Chemistry*. Unit-I,II,III,IV, V
4. Concise inorganic chemistry J.D.Lee. Unit-III,IV, V
5. Instrumental methods of chemical analysis H. Kaur. Unit-V
6. Chemistry for engineers by S.K.Jain, R.S. Thakure. Unit-V
7. Industrial chemistry by B. K. Sharma. 5<sup>th</sup> Ed. Unit -V

### Additional Reading:

1. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
2. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
3. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
4. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
5. Rodgers, G.E. *Inorganic & Solid State Chemistry* Cengage Learning India Ltd 2008.
6. Puri & Sharma. Principles of Physical chemistry.

## Course Code: BCP-403

### Learning Objectives:

1. To study different instruments.



2. To study the gravimetric analysis technique.
3. To find the purity of different inorganic samples.
4. To study semi-micro Qualitative Analysis.

**Note :1. Use of Electronic / Analytical Balance is allowed.**

**2. Use of scientific calculator is allowed.**

**Part[A] :Instrumental**

**1. Viscosity :**

To determine the percentage composition of a given liquid mixture by viscosity method. (Density data to be given).

**2. Refractometry :**

To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer and hence determination of the refraction of -CH<sub>2</sub>- group (Methylene group). (Densities should be determined by students.)

**3. Conductometry:**

- 1) Determination of cell constant of a conductivity cell using standard KCl (N/10 or N/50) solutions
- 2) To determine degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.
- 3) To determine the normality of the given strong acid by titrating it against strong alkali conductometrically.
- 4) To determine the normality of the given weak acid by titrating it against strong alkali conductometrically.

**Part [B]: Non - Instrumental**

**4. Chemical Kinetics**

- 1) To study the hydrolysis of methyl acetate in presence of HCl and H<sub>2</sub>SO<sub>4</sub> and to determine the relative strength of acids.
- 2) To study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester.
- 3) To study the kinetics of the reaction between K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> and KI in solution with unequal initial concentration of the reactants
- 4) To study the reaction between potassium bromate and potassium iodide (KBrO<sub>3</sub> KI) in solution and hence to determine the order of the reaction.

**5. Gravimetric Analysis:**

- a) Gravimetric estimation of iron as ferric oxide from the given solution of ferrous ammonium sulphate and free sulphuric acid
- b) Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride and free hydrochloric acid

#### **6. Inorganic Preparations:**

- a) Preparation of ferrous ammonium sulphate ( Mohr's salt)
- b) Preparation of tetrammonium copper (II) sulphate
- c) Preparation of chloropentammine cobalt (III) chloride

#### **7. Titrimetric Estimations:**

- a) Determination of percentage purity of given sample of soda ash
- b) Determination of total hardness of water using 0.01M EDTA solution
- c) Determination on Percentage purity of tetramine copper (II) sulphate

#### **8. Inorganic Semi-micro Qualitative Analysis :**

Analysis of Inorganic binary mixture :

Anions:  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{CO}_3^{2-}$

Cations:  $\text{Cd}^{++}$ ,  $\text{Fe}^{++}$ ,  $\text{Al}^{+++}$ ,  $\text{Cr}^{+++}$ ,  $\text{Zn}^{++}$ ,  $\text{Mn}^{++}$ ,  $\text{Co}^{++}$ ,  $\text{Mg}^{++}$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Ba}^{++}$ ,  $\text{Cu}^{++}$

#### **Learning Outcomes:**

1. Students learn Gravimetric analysis.
2. Learn to standardise and to titrimetric estimations.
3. Students learn inorganic semi- micro qualitative analysis.
4. Students learn to operate viscometer and measure time of flow for liquids.
5. Measurement of refractive index and calculation of specific and molar refractivities.

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