

**B.Sc II yr CHEMISTRY**  
**SEMESTER WISE SYLLABUS**  
**SEMESTER III**  
**Paper-III**  
**Chemistry - III**

**Unit-I (Inorganic Chemistry)**

**15 h (1 hr/week)**

**S3-I-1: Chemistry of f-block elements:**

**6 h**

Chemistry of Lanthanides: Position in periodic table, Electronic structure, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation- type of donor ligands preferred. Magnetic properties- paramagnetism. Colour and spectra, f-f transitions – occurrence and separation – ion exchange method, solvent extraction.

Chemistry of actinides- general features – electronic configuration, oxidation state, actinide contraction, colour and complex formation. Comparison with lanthanides.

**S3-I-2: Symmetry of molecules**

**5 h**

Symmetry operations and symmetry elements in molecules. Definition of Axis of symmetry types of  $C_n$ , Plane of symmetry ( $\sigma_h$ ,  $\sigma_v$ ,  $\sigma_d$ ) Center of symmetry and improper rotational axis of symmetry ( $S_n$ ). Explanation with examples.

**S3-I-3: Non – aqueous solvents**

**4 h**

Classification and characteristics of a solvent. Reactions in liquid ammonia – physical properties, auto-ionisation, examples of ammonium acids and ammonium bases. Reactions in liquid ammonia – precipitation, neutralization, solvolysis, solvation - solutions of metals in ammonia, complex formation, redox reactions. Reactions in HF – autoionisation, reactions in HF – precipitation, acid – base reactions, protonation.

**Unit - II (Organic chemistry) 15 h (1 hr/week)**

**S3-O-1: Alcohols**

**6 hrs**

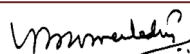
Preparation: 1°, 2° and 3° alcohols using Grignard reagent, Ester hydrolysis, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, HX/ $ZnCl_2$  (Lucas reagent), esterification, oxidation with PCC, alk.  $KMnO_4$ , acidic dichromates, conc.  $HNO_3$  and Oppenauer oxidation.

Diols: Pinacol - pinacolone rearrangement

**Phenols:** Preparation: (i) from diazonium salts of anilines, (ii) from benzene sulphonic acids and (iii) Cumenehydroperoxide method.

Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution nitration, halogenation and sulphonation. Reimer-Tiemann reaction, Gattermann-Koch reaction, Azo-coupling reaction, Schotten-Bouman reaction, Houben-Hoesch condensation,  $FeCl_3$  reaction.

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**S3-O-2: Ethers and epoxides****2hrs**

Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc.  $\text{H}_2\text{SO}_4$ . Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc.  $\text{H}_2\text{SO}_4$  and HI.

**S3-O-3 Carbonyl compounds****7 h**

Nomenclature of aliphatic and aromatic carbonyl compounds and isomerism.

Preparation of aldehydes & ketones from acid chloride, 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzal halides Physical properties – absence of Hydrogen bonding. Keto-enol tautomerism, polarisability of carbonyl groups, reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a)  $\text{NaHSO}_3$  (b) HCN (c)  $\text{RMgX}$  (d)  $\text{NH}_3$  (e)  $\text{RNH}_2$  (f)  $\text{NH}_2\text{OH}$  (g)  $\text{PhNHNH}_2$  (h) 2,4DNP (Schiff bases). Addition of  $\text{H}_2\text{O}$  to form hydrate (unstable), comparison with chloral hydrate (stable), addition of alcohols - hemiacetal and acetal formation. Base catalysed reactions with mechanism- Aldol, Cannizzaro reaction, Perkin reaction, Benzoin condensation, haloform reaction, Knoevenagel condensation. Oxidation reactions –  $\text{KMnO}_4$  oxidation and auto oxidation, reduction – catalytic hydrogenation, Clemmenson's reduction, Wolf-kishner reduction, Meerwein-Ponndorf-Verly reduction, reduction with LAH,  $\text{NaBH}_4$ . Analysis – 2,4-DNP test, Tollen's test, Fehling's test, Schiff's test, haloform test (with equations).

**UNIT – III (Physical Chemistry)****15 hr (1h / week)****S3-P-1: Phase Rule****6 h**

Statement and meaning of the terms – Phase, Component and degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two-component system – Solid-Liquid equilibria, simple eutectic – Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – Mg-Zn system and incongruent melting point – NaCl- $\text{H}_2\text{O}$  system.

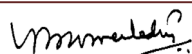
**S3-P-2: Colloids & surface chemistry****9 h**

Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties – (including Kinetic, Optical and Electrical stability of colloids) Protective action. Hardy-Schultz law, Gold number. Liquids in liquids (emulsions): Types of emulsions, preparation and emulsifier. Liquids in solids (gels); Classification, preparations and properties, General applications of colloids.

Micelles: Classification of surface active agents. Surfactant action, micellization and micellar interactions, Structure of micelles – spherical and lamellar. Critical micellar concentration (CMC). Factors affecting the CMC of surfactants. Counter ion binding to micelles.

**Adsorption:** Types of adsorption, Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.

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## Unit –IV (General Chemistry)

15 h (1h/week)

### S3-G-1: Nanomaterials:

3h

Nano structured materials – Definition, size, description of graphene, fullerenes, carbon nano tubes. Synthetic techniques, bottom-up-sol-gel method, top-down, electro deposition method. Production of carbon nano tubes – arc discharge, laser vaporization methods. General applications of nano materials.

### S3-G-2: Stereochemistry of carbon compounds

10 h

Isomerism: Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers – definitions and examples.

Optical activity: Definition, wave nature of light, plane polarised light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and  $S_n$  axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans-1,2-dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-dibromopentane) Number of enantiomers and mesomers - calculation. D, L & R, S configuration for asymmetric and dissymmetric molecules (Allenes, spiro compounds and biphenyls), Cahn-Ingold-Prelog rules. Racemic mixture, Racemisation and Resolution techniques. Geometrical isomerism with reference to alkenes and cyclo alkanes– cis, trans and E, Z configuration.

### S3-G-3: Conformational analysis

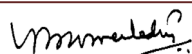
2 h

Classification of stereoisomers based on energy. Definition and examples of conformational and configurational isomers. Conformational analysis of ethane, n-butane, 1,2-dichloroethane, 2-chloroethanol and methylcyclohexane

## Referances:

### Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup>edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L.Gaus 3<sup>rd</sup>edn Wiley Publishers 2001.
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4<sup>th</sup>edn.
5. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
6. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup>edn Oxford Press 1999.
7. Textbook of Inorganic Chemistry by R Gopalan
8. College Practical chemistry by V K Ahluwalia, SunithaDhingra and Adarsh Gulati



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## Unit- II

1. Text book of organic chemistry by Soni.
2. General Organic chemistry by Sachin Kumar Ghosh.
3. Text book of organic chemistry by Morrison and Boyd.
4. Text book of organic chemistry by Graham Solomons.
5. Text book of organic chemistry by Bruce Yuranis Powla.
6. Text book of organic chemistry by C N pillai

## Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Text Book of Physical Chemistry by K. L. Kapoor.
5. Colloidal and surface chemistry , M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal and M.S.sethi
6. Material science by Kakani&Kakani

## Unit IV

1. Text book of organic chemistry by Morrison and Boyd
2. Text book of organic chemistry by Graham solomons
3. Text book of organic chemistry by Sony
4. Text book of organic chemistry by Bruce yuranis Powla
5. General Organic chemistry by Sachinkumar Ghosh

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*Uncommented?*

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## Laboratory Course

### Paper III- Quantitative Analysis - I

45hrs (3 h / week)

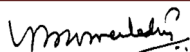
#### Acid - Base titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.
4. Estimation of Alkali content in Antacid using HCl.

#### Redox Titrations

1. Determination of Fe(II) using  $K_2Cr_2O_7$
2. Determination of Fe(II) using  $KMnO_4$  with sodium oxalate as primary standard.
3. Determination of Cu(II) using  $Na_2S_2O_3$  with  $K_2Cr_2O_7$  as primary standard

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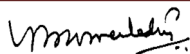
## Laboratory Course

### Paper IV- Quantitative Analysis - II

45hrs (3h/ week)

1. Conductometry titrations:
  - i) Strong acid Vs Strong base;
  - ii) Weak acid Vs Strong base.
2. Potentiometry titration:
  - i) Strong acid Vs Strong base;
  - ii) Weak acid Vs Strong base.
3. Estimation of Nickel by back titration (Standard  $\text{MgSO}_4$  solution will be given)
4. Estimation of Barium as Barium Sulphate

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