

Affiliated Sant Gadge Baba Amravati University Amravati.

## **Department of Chemistry**

**B.Sc- II Year Sem- III**

**3Sem Chemistry**

**(Effective from session 2014-15)**

The examination in Chemistry of Third semester shall comprise of one theory paper, internal assessment and practical examination.

Theory paper will be of 3 Hrs. duration and carry 80 marks.

The internal assessment will carry 20 marks.

The practical examination will be of 6 hours duration and carry 50 marks.

The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week.

Each theory paper has been divided into 6 units.

There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-III (8 marks).

### **B.Sc. Part- II (Semester- III)**

**3S Chemistry**

**Total Lectures: 84 Marks: 80**

Note: Figures to the right hand side indicate number of lectures.

#### **Unit I**

**14L**

**A] Covalent Bonding:** Molecular Orbital Theory. Postulates of MO theory. LCAO

approximation. Formation of bonding and antibonding MOs. Rules for LCAO. MO energy level diagram. Concept of bond order. MO structure of homonuclear diatomic molecules of namely  $\text{He}_2$ ,  $\text{H}_2$ ,  $\text{N}_2$  and  $\text{O}_2$ . Stability sequence of species of  $\text{O}_2$  i.e.  $\text{O}_2$ ,  $\text{O}_2^+$ ,  $\text{O}_2^{2+}$ ,  $\text{O}_2^-$  and  $\text{O}_2^{2-}$ .

Paramagnetic nature of  $\text{O}_2$ . MO structure of heteronuclear diatomic molecules viz. NO, HF and

CO (Coulson's structure). Explanation of important properties of CO viz. - triple bond, almost nonpolar nature, electron donor and acceptor behaviour. Comparison of VB and MO theories.

**B] Metallic Bonding:** Free electron theory and properties of metals such as electrical and thermal conduction, malleability, ductility and metallic lustre. VB theory or Resonance theory of metals. Band theory to explain nature of conductors, insulators and semiconductors (both intrinsic and extrinsic).

**C] VSEPR Theory:** Various rules under VSEPR theory to explain molecular geometry (following examples may be taken to explain various rules-  $\text{BeCl}_2$ ,  $\text{BF}_3$ ,  $\text{CH}_4$ ,  $\text{NH}_4^+$ ,  $\text{PCl}_5$ ,  $\text{SF}_6$ ,  $\text{IF}_7$ ,  $\text{SnCl}_2$ ,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{BrF}_5$ ,  $\text{XeF}_6$ ,  $\text{SOF}_4$ ,  $\text{COF}_2$ ,  $\text{PCl}_3$ , ). Limitations of VSEPR theory.

### Unit II - Theory of Quantitative Inorganic Analysis

14L

**A] Volumetric Analysis:**

**(a) Introduction:-** Volumetric analysis, titrant, titrate, end point, equivalence point, indicator etc. Requirements of volumetric analysis. Definition of standard solution, primary standard substance. Requirements of primary standard substance. Terms to express concentrations namely- molarity, normality, molality, mole fraction and percentage. (Simple numericals expected).

**(b) Acid-Base titrations:-** Types of acid base titrations. pH variations during acid base titration. Acid base indicators. Modern theory (Quinoniod theory) of acid base indicators. Choice of suitable indicators for different acid base titrations.

**(c) Redox Titrations:-** General principles involved in redox titrations (redox reactions, redox potentials, oxidant, reductant, oxidation number). Brief idea about use of  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$  as oxidants in acidic medium in redox titrations. Use of  $\text{I}_2$  in iodometry and iodimetry. Redox indicators-external and internal indicators. Use of starch as an indicator. Iodometric estimation of Cu (II).

**B] Gravimetric Analysis:** Definition. Theoretical principles underlying various steps involved in gravimetric analysis with reference to estimation of barium as barium sulphate. Coprecipitation and post precipitation. (Definition, types and factors affecting).

**Unit III**

**14L**

**A]** Aldehydes and Ketones: Preparation of acetaldehyde from ethanol, ethylidene chloride and acetylene. Preparation of benzaldehyde from benzene (Gattermann-Koch reaction) and toluene. Preparation of acetone from isopropyl alcohol, isopropylidene chloride and propyne. Preparation of acetophenone from benzene and ethyl benzene. Structure of carbonyl group, acidity of  $\alpha$ -hydrogen in carbonyl compounds. Reactions of aldehydes &/or ketones: Cannizzaro's, Reformatsky, Perkin with mechanism, Mannich reaction, Benzoin and Aldol condensations. Clemmensen, Wolf-Kishner, MPV and  $\text{LiAlH}_4$  reductions.

**B]** Carboxylic acids: Structure and reactivity of carboxylic groups. Acidity of carboxylic acids, effects of substituents on acids strength. Oxalic acid: Preparation from ethylene glycol and cyanogen. Reactions: Reaction with ethyl alcohol, ammonia, glycerol and action of heat. Lactic acid: Preparation from acetaldehyde and pyruvic acid. Reactions: Reaction with ethanol,  $\text{PCl}_5$ , action of heat, oxidation and reduction. Benzoic acid: Preparation from toluene, benzyl alcohol, phenyl cyanide and benzamide. Reactions : Reaction with ethanol,  $\text{PCl}_5$  and ammonia. Salicylic acid: Preparation by Reimer-Tiemann reaction. Reactions: Reaction with  $\text{CH}_3\text{COCl}$ ,  $\text{CH}_3\text{OH}$  and  $\text{C}_6\text{H}_5\text{OH}$ .

**Unit IV**

**14L**

**A]** Optical isomerism: Element of symmetry, chirality, asymmetric carbon atom, enantiomers, diastereoisomers, relative and absolute configurations, DL and RS nomenclature, racemisation and resolution (by chemical method).

**B]** Geometrical isomerism: Cis-trans & E-Z nomenclature, Methods of structure determination.

**C]** Conformational isomerism: Bayer's Strain theory and its limitations. Stability of cycloalkanes, conformational isomers of ethane, n-butane and cyclohexane, their energy level diagrams. Newman & Sawhorse projection formulae.

**Unit V**

**14L**

**A]** Thermodynamics and Equilibrium:

- (i) Gibb's and Helmholtz's free energy function. Physical significance of Gibb's free energy, Change in free energy as a criteria of spontaneity and equilibrium. Variation of free energy  $G$  with  $P$  &  $T$ . Gibb's-Helmholtz's equation in terms of  $G$  and its application.
- (ii) Partial molal function, chemical potential, derivations of Gibb's-Duhem equation. Chemical potential of an ideal gas in gaseous mixture. Derivation of vant Hoff's isotherm and its application to equilibrium state. Derivation of vant Hoff's equation and its applications.
- (iii) Numericals.

### **B] Phase Equilibrium:**

- (i) Immiscible liquids, Nerst distribution law and its application to association and dissociation of solute in one of the solvent. Process of extraction, derivation of formula for the amount of solute left unextracted after  $n$ th extraction.
- (ii) Phase transition - Clausius-Clyperon equation (only qualitative statement).
- (iii) Partially miscible liquids - Phase diagram of phenol-water, triethyl amine - water and nicotine-water systems.
- (iv) Numericals.

## **Unit VI**

**14L**

### **A] Liquid state:**

- (i) Surface tension, determination and its S.I. Unit. Effect of temperature on surface tension, derivation of expression for relative surface tension by Drop number method. Application of surface tension.
- (ii) Viscosity, determination and its S.I. Unit. Effect of temperature on viscosity, derivation of expression for relative viscosity by Ostwald's viscometer method. Applications of viscosity.

### **B] Electrochemistry:**

- (i) Conductance of electrolyte solution. Specific, equivalent and molar conductance. Determination of conductance of electrolyte solution, variation of specific and equivalent conductance with dilution for strong electrolyte. Conductometric titrations. Applications of conductometric titration.
- (ii) Migration of ions under the influence of electric field. Transport number of ions. Determination of transport number by Hottorf's method and Moving boundary method

- (iii) Kohlrausch's law of independent migration of ions. Determination of  $\lambda^\circ$  and degree of dissociation  $\alpha$  of a weak electrolyte. Determination of dissociation constant of weak electrolyte.
- (iv) Numericals.

## Semester- III 3S Chemistry Practicals

**Total Laboratory sessions: 26**

**Marks: 50**

### Exercise I:

#### a) Volumetric Analysis (Standard solutions to be prepared by students only)

##### 16 Laboratory sessions

- 1) Prepare 0.1N oxalic acid standard solution and find out the acid neutralizing capacity of an antacid using NaOH as an intermediate solution.
- 2) Prepare 0.1N  $\text{H}_2\text{SO}_4$  solution and find out its exact normality using NaOH as an intermediate solution and 0.1N oxalic acid as standard solution.
- 3) To determine the strength of oxalic acid by titration with  $\text{KMnO}_4$ .
- 4) To determine percentage purity of Ferrous Ammonium Sulphate (FAS) by titration with  $\text{KMnO}_4$ .
- 5) To determine strength of FAS by titration with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.
- 6) To determine strength of  $\text{K}_2\text{Cr}_2\text{O}_7$  by titration with FAS using internal indicator.
- 7) Estimation of copper (II) in commercial copper sulphate sample by iodometric titration.

#### b) Gravimetric Analysis

Estimation of  $\text{Ba}^{2+}$  as  $\text{BaSO}_4$ ,  $\text{Fe}^{3+}$  as  $\text{Fe}_2\text{O}_3$  using china and silica crucible and  $\text{Ni}^{2+}$  as Ni-DMG using sintered glass crucible.

### Exercise II: Physical Chemistry experiments

##### 10 Laboratory sessions

- 1) To determine refractive index by Abbe's refractometer.
- 2) To construct phase diagram of phenol-water system and to determine consolute temperature for the system.
- 3) To determine transition temperature of  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ .
- 4) To study kinetics of hydrolysis of methyl acetate catalyzed by acid.
- 5) To study kinetics of saponification of ethyl acetate by NaOH. (Equal concentration)

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- 6) To determine partition coefficient of benzoic acid between benzene and water.
- 7) To determine partition coefficient of iodine between  $\text{CCl}_4$  /Kerosene and water.
- 8) To determine solubility of benzoic acid at different temperature and heat of solution

### Distribution of Marks for Practical Examination

**Time: 6 hours (One Day Examination)**

**Marks: 50**

**Exercise-I ..... 18**

**Exercise-II ..... 18**

**Viva-Voce ..... 07**

**Record ..... 07**

**Total : 50 Mark**

### Books Recommended:

**(Common for Semester III and Semester IV)**

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
2. Text book of Inorganic Chemistry by A.K. De, Wiley East Ltd.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and MadanS. Chand & Co.
4. Modern Inorganic Chemistry by R.C. Agrawal, Kitab Mahal.
5. Instrumental Methods of analysis by Chatwal and Anand, Himalaya Publishing House.
6. Concise Inorganic Chemistry by J.D. Lee, ELBS.
7. Inorganic Chemistry by J.E. Huheey- Harper & Row.
8. Fundamental concepts of Inorganic Chemistry by E.S. Gilreath, McGraw Hill book Co.
9. Modern Inorganic Chemistry by W.L. Jolly, McGraw Hill Int.
10. Chemistry Facts, Patterns & Principles by Kneen, Rogers and Simpson, ELBS.
11. Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw Hill.
12. Inorganic complex compounds by Murmann, Chapman & Hall.
13. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
14. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.
15. Co-ordination Chemistry by D. Banerjee, TMH Publication.
16. Text book of Inorganic Chemistry by Nema, Agrawal, Solanki, Morkhade, Meshram, Berad.
17. Text book of Inorganic Chemistry by Bhadange, Pagariya, Deshmukh, Joshi, Bombatkar, Mandlik, Bokey Prakashan, Amravati.

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18. Organic Chemistry by R.T. Morrison & R.T. Boyd, 6th edition, PHI.
19. Organic Chemistry by Pine, 5th edition.
20. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
21. Organic Chemistry by S.K. Ghosh.
22. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
23. Spectroscopy of Organic Compounds by P.S. Kalsi.
24. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
25. Organic Chemistry by TWG Solomons, 4th edition, John Wiley.
26. Hand Book of Organic Analysis by H.J. Clarke, Arnold Heinmen.
27. Text book of Practical Organic Chemistry by A. I. Vogel.
28. Text book of Organic Chemistry by Wadodkar, Raut, Dighade, Thakre, Kale, Kadu, Chincholkar.
29. Text book of Organic Chemistry by P.S. Kalsi published by Macmillan India Ltd., 1999, Delhi.
30. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
31. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.
32. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.
33. Text book of Organic Chemistry by Deshmukh, Awinashe, Tayade, Wadekar, Meshram, Parhate, Bokey Prakashan, Amravati.
34. Physical Chemistry: Walter, J. Moore, 5th edn., Delhi
35. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
36. Principles of Physical Chemistry: Maron and Prutton.
37. Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
38. Physical Chemistry: P.W. Atkins, 4th Edn.
39. Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
40. Physical Chemistry: Levine.
41. Practical Physical Chemistry: Palit and De.
42. Practical Physical Chemistry: Yadao.
43. Practical Physical Chemistry: Khosla.
44. Laboratory Mannual of Physical Chemistry: W.J. Popiel.

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45. Practical Chemistry: Dr. S.B. Lohiya, Bajaj publication, Amravati.
46. Text book of Physical Chemistry: Satpute, Kabra, Raghuwanshi, Wankhade, Jumle and Murarka.
47. Text book of Chemistry, B.Sc.-II, Third Semester & Fourth Semester, Nabh Prakashan.