

Vivekanand College (Autonomous), Kolhapur

B. Sc. Part II (Chemistry) CBCS Syllabus

In force from June-2019

General Structure

There will be one theory paper for each semester of 80 marks and internal examination of 20 marks.

Semester III

Paper III: Physical and Organic Chemistry **80 Marks**

Semester IV

Paper IV: Inorganic and Physical Chemistry **80 Marks**

There will be annual practical examination. Practical will be of 100 marks. Physical, Organic and Inorganic sections carry 25, 30 and 35 marks respectively and 10 marks for journal. The duration of practical examination will be of Two days (6 hrs each day).

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Semester-III Chemistry Paper-III

Chemistry-DSC-2C Physical and Organic Chemistry

Theory: 60hrs (75 Lectures) Credits-4

Section I: Physical Chemistry

(38 Periods)

Unit-I: Solutions

(8)

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law, non-ideal solutions, Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions, Distillation of solutions, Azeotropes, Partial miscibility of liquids, Critical solution temperature; effect of impurity on partial miscibility of liquids, Immiscibility of liquids-Principle of steam distillation, Nernst distribution law and its applications, solvent extraction.

Unit -II: Phase Equilibria

(10)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium, Gibbs Phase Rule, Clausius-Clapeyron equation and its importance, Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $\text{FeCl}_3\text{-H}_2\text{O}$ and KI-Water only).

Unit -III: Electrochemistry-I (Conductance)

(10)

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes, Transference number and its experimental determination using Moving boundary methods, Kohlrausch law of independent migration of ions, Applications of conductance measurements: determination of degree of ionization of weak and strong electrolyte, Conductometry titrations Strong Acid-Strong Base, Weak Acid-Strong Base.

Unit-IV: Electrochemistry-II (Electrochemical Cell)

(10)

Reversible and irreversible cells, Nernst equation and its importance, Types of electrodes, Standard electrode potential, electrochemical series, determination of thermodynamic

Properties: ΔG , ΔH and ΔS from EMF data, Calculation of equilibrium constant from EMF data, Concentration cell, electrolyte concentration cell without transference only, Liquid junction potential and salt bridge, pH determination using hydrogen electrode and quinhydrone electrode

Reference Books

1. Barrow, G. M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B. H. *University Chemistry*, 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).

Section II: Organic Chemistry

(37 Periods)

Unit I: Carboxylic acids and their derivatives (8)

A] Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters.

Reactions: Hell -Vohlard - Zelinsky Reaction.

B] Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Amides from acids and their interconversion, preparation of Esters with mechanism.

Reactions: Comparative study of nucleophilicity of acyl derivatives; Reformatsky Reaction, Perkin condensation with mechanism and their applications.

Unit II: Amines and Diazonium Salts (8)

Aliphatic and Aromatic Amines (Upto 5 carbons)

Preparation: from alkyl halides, alkyl nitriles, Gabriel's Phthalimide synthesis, Hofmann Bromamide Reaction.

Reactions: Carbylamine test, Hinsberg test, with HNO_2 , Gamberg's Reaction, Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: Preparation from aromatic amines, types of Diazotisation methods, Synthesis of methyl orange dye; Reactions for Conversion to benzene, phenol, dyes.

Unit III: Amino Acids, Peptides and Proteins

(9)

A] Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis, Zwitterion, Isoelectric point and Electrophoresis.

B] Reactions of Amino acids: ester of -COOH group, acetylation of -NH₂ group, complexation with Cu²⁺ ions, ninhydrin test, biurate test, overview of Primary, Secondary, Tertiary and quaternary structure of proteins, structure of amylose and amylopectin; Determination of Primary structure of Peptides by degradation- Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme).

Unit IV: Carbohydrates

(12)

Classification and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides, Structure of disaccharides, hydrolysis reaction of Disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose), determination of size of ring.

Reference Books

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M., *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
5. Berg, J.M., Tymoczko, J. L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
6. Name reactions by G. Jack Lee.

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B. Sc. Part-II (Chemistry) CBCS Syllabus with effect from June-2019
Semester-IV, Chemistry Paper-IV
Chemistry-DSC-2D Inorganic and Physical Chemistry
Theory: 60hrs (75 Lectures) Credits-4

Section I: Inorganic Chemistry

(37 Periods)

Unit 1: Transition Elements (3d series)

(5)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties and ability to form complexes.

Unit 2: Lanthanoids and Actinoids

(8)

A] Lanthanoids: Introduction, electronic configurations, oxidation states, colour and spectra, magnetic properties, lanthanide contraction, occurrence and separation of lanthanides (ion exchange method only).

B] Actinoids: Introduction, position in periodic table, electronic configuration, oxidation states; General methods of preparation of Transuranic elements- i) Neutron capture followed by β decay ii) Accelerated projectile bombardment iii) Heavy ion bombardment; IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100.

Unit 3: Coordination Chemistry: Theories of Metal Complexes

A] Valence Bond Theory

(9)

Definition and formation of co-ordinate covalent bond in $\text{BF}_3\text{-NH}_3$ and $[\text{NH}_4]^+$, Distinguish between double salt and complex salt, Werner's theory i) Postulates, ii) theory as applied to cobalt amines complexes; Description of the terms: ligands, co-ordination compounds, Coordination number; IUPAC system of nomenclature, Structural and stereoisomerism in complexes with coordination numbers 4 and 6; postulates of VBT, Inner and outer orbital complexes w. r. t. coordination numbers 4 and 6; Drawbacks of VBT.

B] Crystal Field Theory

(10)

Assumptions of CFT, Crystal field splitting of 'd' orbital in octahedral, tetrahedral and square planar complex, Crystal field stabilization energy (CFSE), Comparison of CFSE for *Oh* and *Td* complexes, Crystal field effects for weak and strong fields ligands, Tetrahedral

symmetry, Factors affecting the Magnitude of 10 Dq, Spectrochemical series, Jahn-Teller distortion, Limitations of CFT.

C] Molecular Orbital Theory [MOT] (5)

Introduction, Salient features of MOT of octahedral complexes with sigma bonding such as $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, Merits and demerits of MOT.

Reference Books

1. Cotton, F. A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
2. Shriver, D. F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
3. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
4. Rodgers, G. E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.
5. Lee, J. D. *Concise Inorganic Chemistry*, (ELBS, 5th Edition)
6. Puri, Sharma and Kalia; *Principles of Inorganic Chemistry*, Vallabh Publication, Pitampur Delhi.
7. Gopalan R. and Ramalingam V.; *Concise Coordination Chemistry*, Vikas Publishing House Pvt. Ltd.

Section II: Physical Chemistry (38 Periods)

Unit I: Kinetic Theory of Gases (10)

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation, Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation, van der Waals equation of state for real gases, Boyle temperature (derivation not required), Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews's isotherms of CO_2 , Most probable, average and root mean square velocities (no derivation), Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules.

Unit II: Liquids (8)

Properties of liquids- surface tension, Parachor Value, Viscosity, refractive index etc. and its determination, Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Unit III: Solids

(10)

Forms of solids, unit cells, crystal systems, Bravais lattice types and identification of lattice planes, Laws of Crystallography-Law of constancy of interfacial angles, Law of rational indices, Law of crystal symmetry Miller and wise indices, X-Ray diffraction by crystals, Bragg's law, Structures of NaCl, KCl (qualitative treatment only),

Unit IV: Chemical Kinetics

(10)

The concept of reaction rates, Effect of temperature, pressure, catalyst and other factors on reaction rates, Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants), General equations for rate constants, Half-life of a reaction, General methods for determination of order of a reaction, Concept of activation energy and its calculation from Arrhenius equation.

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1. Barrow, G. M., *Physical Chemistry*, Tata McGraw-Hill (2007).
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5. Petrucci, R. H., *General Chemistry*, 5th Ed. Macmillan Publishing Co.: New York (1985).

B. Sc. II Syllabus for Practical

Section I: Inorganic Chemistry

1. Semi-micro qualitative analysis using H₂S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:
Cations: NH₄⁺, Cu²⁺, Cd²⁺, Fe³⁺, Al³⁺, Co²⁺, Cr³⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺, Mg²⁺.
Anions: CO₃²⁻, S²⁻, SO₃²⁻, S₂O₃²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, SO₄²⁻, C₂O₄²⁻, F⁻ (*Spot tests should be carried out wherever feasible*).
2. Estimate the amount of metal present in a given solution gravimetrically. (Any three)
 - a) Ni as Ni-DMG
 - b) Ba as BaSO₄
 - c) Fe as Fe(OH)₃

- d) Al as Al oxinate.
- To determine the unknown concentration of given coloured compounds (KMnO_4 / CuSO_4) colorimetrically.
 - Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
 - Preparation of Hexamine Nickel Chloride.
 - Estimation of total hardness of a given sample of water by complexometric titration.
 - To determine volumetrically the amounts of sodium carbonate and sodium hydroxide present together in the given solution.
 - Determination of alkali content of antacid tablet using HCl.
 - To estimate H_2O_2 by Iodometric method.
 - Preparations of Ferrous ammonium sulphate (Mohr's salt).
 - Preparation of Potash Alum.

Section II: Organic Chemistry

- Organic Spotting:** Carboxylic acids, phenolic, aldehydic, ketonic, amide, nitro, amines (at least 6 compounds) and preparation of one derivative.
- Preparation of methyl orange
- Preparation of p-nitro acetanilide
- Determination of the concentration of glycine solution by formylation method.
- Estimations of Vitamin-C from tablets
- Action of salivary amylase on starch
- Estimation of Acetone
- Differentiation between a reducing and a non-reducing sugar.

Section III: Physical Chemistry

- Determination of the surface tension of a liquid or a dilute solution using a Stalagmometer.
- Study of the variation of surface tension of a detergent solution with concentration.
- Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- To investigate the reaction between potassium per sulphate and KI (Equal Concentration)
- To investigate the reaction between potassium persulphate and KI (Unequal Concentration)
- To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine relative strength.

7. To determine Cell Constant of the given Conductivity cell and to verify Ostwald dilution law using acetic acid Solution Conductometrically.
 8. To determine the normality of given strong acid and weak acid by titrating it against strong base Conductometrically.
 9. To determine the normality of given strong acid by titrating it against strong base Potentiometrically.
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Reference Books

1. Vogel, A. I., Tatchell, A. R., Furnis, B. S., Hannaford, A. J. & Smith, P. W. G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
2. Mann, F. G. & Saunders, B. C. *Practical Organic Chemistry*, Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V. K. & Aggarwal, R., *Comprehensive Practical Organic Chemistry*, Universities Press.
5. Svehla, G., *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
6. Mendham, J., *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
7. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).