

Shree Govind Guru University

GODHRA

Syllabus of B.Sc. Sem.I/Sem.II

CHEMISTRY

Theory & Practicals

(Based on CBCS)

Effective from June 2016

----- Semester I -----

General Chemistry

Paper 101

(Credits: Theory-04, Practicals-02)

Theory: 48 Lectures

Section A: Inorganic Chemistry-1 (24 Lectures)

Unit I

(14 marks)

Atomic Structure:

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms upto atomic number 30. Stability of half-filled and completely filled orbitals, concept of exchange energy.

(12 Lectures)

Unit II

(14 marks)

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear(BeH_2), trigonal planar(BF_3), square planar(PtCl_4^{2-}) arrangements.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st(H_2, H_2^+) and 2nd(N_2, O_2) periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+ .

(12 Lectures)

Section B: Organic Chemistry-1 (24 Lectures)

Unit III (14 marks)

A. Fundamentals of Organic Chemistry (4 marks)

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

(5 Lectures)

B. Stereochemistry (10 marks)

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms).

Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds) cis - trans nomenclature and E / Z Nomenclature (for upto two C=C systems).

(7 Lectures)

Unit IV (14 marks)

Aliphatic Hydrocarbons

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine), Hydration, Ozonolysis, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alk. KMnO_4 .

(12 Lectures)

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
 - Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
 - Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
 - Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
 - Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
 - McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
 - Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
 - Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
 - Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
 - Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
 - Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
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----- Semester I -----

Chemistry Practicals (12 Practicals)

Paper 102

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
4. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements) Urea, Thiourea, Benzoic Acid, Beta-Naphthol, OrthonitroAniline, Anthracene, Chlorobenzene, Bromobenzene, Aniline)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
 - Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
 - 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.
 - Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
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----- Semester II -----

General Chemistry

Paper 103

(Credits: Theory-04, Practicals-02)

Theory: 48 Lectures

Section A: Physical Chemistry-1 (24 lectures)

Unit I (14 marks)

A. Chemical Energetics (7 marks)

Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(6 Lectures)

B. Chemical Equilibrium: (7 marks)

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG_0 , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

(6 Lectures)

Unit II (14 marks)

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions.

(12 Lectures)

Section B: Organic Chemistry-2 (24 Lectures)

Unit III

(14 marks)

A. Aromatic hydrocarbons

(4 marks)

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation)

(5 Lectures)

B. Alkyl and Aryl Halides

(10 marks)

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis

Aryl Halides *Preparation:* (Chloro, bromo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $\text{NaNH}_2/\text{NH}_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

(7 Lectures)

Unit IV

(14 marks)

A. Alcohols, Phenols and Ethers (Upto 5 Carbons)

(7 marks)

Alcohols: Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO_4 , acidic dichromate, conc. HNO_3). (Upto 6 Carbons)

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts.
Reactions: Electrophilic substitution: Nitration, halogenation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

(6 lectures)

B. Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, Acetaldehyde, Acetone and Benzaldehyde) (7 marks)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, NaHSO_3 , NH_2 -G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemmensen reduction and Wolff Kishner reduction.

(6 Lectures)

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985). -----

----- Semester II -----

Chemistry Practicals (12 Practicals)

Paper 104

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of ionization of acetic acid.
3. Study of the solubility of benzoic acid in water and determination of ΔH .

Ionic equilibria

- a) Measurement of pH
 - i) Determination of concentration of strong acid using pH meter.
 - ii) Determination of concentration of weak acid using pH meter.
- b) Preparation of buffer solutions:
 - (i) Sodium acetate-acetic acid
 - (ii) Ammonium chloride-ammonium hydroxide

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation: Benzoic Acid, Cinnamic Acid, Acetanilide, Urea, Anthracene, Acetone, Ethyl Acetate.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books :

- 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.
 - Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
 - Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
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