

**JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER**

Programme: B.Sc.

Semester: III

CHEMISTRY PAPER III

Course Code: 18IIIICH3

No. of Hours: 60

COURSE OBJECTIVES:

By the end of the course students should be able to:

- Explain concepts in Maxwell Boltzmann distribution of molecular velocities of gases, Second law of thermodynamics and Kinetics of second order reaction and solve numericals based on the equations studied
- Write structures of Alcohols, Ethers and Phenols, discuss their properties and be able to explain selected reaction mechanisms and synthetic applications.
- Discuss synthetic applications of Organo lithium compounds and Organic polymers
- Do a comparative study of d and f block elements.
- Use Ellingham diagram for selection of reducing agents and explain extraction of certain metals from specific ores.
- Handle advanced laboratory techniques for synthesis, separation and purification of organic compounds, and detect the special element in an organic compound (The laboratory component)

LEARNING OUTCOMES:

On completion of this course, the student should be able to:

- Explain the behaviour of gaseous systems based on movement of molecules
- Apply their knowledge of alcohols, ethers, phenols and thioethers in organic reactions
- Apply the chemistry of organometallic compounds in order to design effective catalysts
- Understand the chemistry of d and f block elements and correlate their properties
- Apply the basic principles of metallurgy to aid in industrial research.
- Outline a single step synthesis for compounds containing upto two functional groups. (the laboratory component)

UNIT I

Chapter 1 - GASES

07 HRS

Review: Kinetic theory of gases.

Maxwell Boltzmann distribution of molecular velocities, derivation of expression for most probable velocity, expression for average and root mean square velocity (no derivation),

relationship between them. Problems. Andrew's experiment on CO_2 , critical constants and their determination, relationship with Van der Waals constants, Joule- Thompson effect. Inversion temperature and their applications to the liquefaction of air and hydrogen. Law of corresponding states. Problems.

Chapter 2 - ORGANIC POLYMERS

03 HRS

Introduction. Types of polymerisation – addition and condensation. Expressions for number and mass average molar masses of polymers. Problems. Preparation and applications of the following types of polymers:(i) Plastics:(a)thermosetting: Phenol-formaldehyde(novolac and resol) and polyurethane resins (b) thermosoftening: PVC, polystyrene (ii) Fibres: Acrylic : orlon, polyamide: nylon 6,6; nylon 6,10 (iii) Rubber: (a)Natural (polyisoprene) and (b)synthetic rubber (neoprene), concept of vulcanisation (iv) Fluorocarbons: Teflon.

UNIT II

Chapter 3 - ALCOHOLS AND ETHERS

08 HRS

Alcohols: Introduction,classification and methods of preparation: (i) reduction of aldehydes, ketones – Meerwein-Ponndorf-Verley reaction,(ii) From acid/esters – Reduction with Lithium aluminium hydride.(iii) Hydroboration- oxidation (iv) Hydration of alkenes. Reactions of alcohols- acidic nature, formation of alkoxides, esterification, oxidation with KMnO_4 ,comparison of reactivities of primary, secondary and tertiary alcohols – Lucas' test, oxidation with $\text{K}_2\text{Cr}_2\text{O}_7$.

Glycol: Preparation from alkenes using OsO_4 , KMnO_4 and from epoxides; oxidation of glycols by periodic acid,lead tetra acetate (with mechanism). Pinacol-pinacolone rearrangement (with mechanism).

Glycerol: Preparation from oils and fats, synthesis from propene, reactions: nitration, reaction with conc. H_2SO_4 and oxidation with HIO_4 . Trans esterification : glycerol as by-product of biodiesel.

Ethers: Methods of preparation – Dehydration of alcohols, Williamson's ether synthesis. Reactions: Ethers as Lewis bases (Complexation with metals ions), cleavage and auto-oxidation; Ziesel's method.

Chapter 4 – PHENOLS

04 HRS

Classification, acidic nature - comparison of acidic strength with alcohols and carboxylic acids, effect of substituents on acid strength: NO_2 , NH_2 and CH_3 (at ortho position only). Reactions of phenols: Mechanism of Kolbe - Schmidt's and Riemer-Tiemann reactions. Elb's reaction, Pechmann reaction. Synthetic applications: conversion of phenols to (i) Aspirin (ii) Methyl salicylate (iii) salol (iv) salicyl-salicylic acid.

Chapter 5 - THIOLS AND THIOETHERS

02 HRS

Thiols: Nomenclature, Methods of preparation – from alkyl halides, Grignard reagents and alkenes. Reactions: with sodium metal, sodium hydroxide, metal oxides and formation of thioesters.

Thioethers: Methods of preparation – from alkyl halides, ethers and thiols. Reactions with alkyl halides and halogens, hydrolysis and oxidation.

UNIT III

Chapter 6 - ORGANOMETALLIC COMPOUNDS

02 HRS

Preparation and synthetic applications of organo lithium compounds (Synthesis of alkanes, carboxylic acids and alcohols) and lithium dialkylcuprate (synthesis of alkanes).

Chapter 7 - GENERAL STUDY OF D- AND F- BLOCK ELEMENTS

07 HRS

Review of Transition elements-electronic configuration, atomic and ionic radii, ionisation energy, oxidation states, colour.

Preparation, Properties and uses of some compounds of d & f block elements: Mercurous chloride, Nessler's reagent, Vanadium pentoxide, Ceric ammonium sulphate. Magnetic & catalytic activity, interstitial compound formation of transition metals with suitable examples.

Lanthanides and actinides: electronic configuration, atomic and ionic sizes, consequences of lanthanide contraction, oxidation states, magnetic and spectral properties. Comparison of d and f block elements : oxidation states, complex formation and magnetic properties. Ion exchange method of separation of lanthanides from solution.

Chapter 8 – METALLURGY

06 HRS

Thermodynamic concept: selection of reducing agents (Carbon, Aluminium, Zinc and Chromium) using Ellingham diagrams for metal oxides. Extraction of Ni from sulphide ore,

Cr from chromite ore. Extraction of thorium from monazite sand, uranium from pitch blende and plutonium from nuclear waste.

UNIT IV

Chapter 9 - THERMODYNAMICS – 2

10 HRS

Need for the second law of thermodynamics- different ways of stating second law. Significance of entropy. Heat engine, Carnot cycle and its efficiency (derivation), calculation of entropy changes in different processes, free energy, work function and chemical potential. Criteria for equilibrium and spontaneous processes.

Variation of free energy with pressure, derivation of van't Hoff isotherm, Gibbs-Helmholtz equations, van't Hoff isochore and Clausius-Clapeyron equation. Applications of Clausius-Clapeyron equation (no derivation). Problems. Zeroth law of thermodynamics.

Qualitative treatment of Nernst heat theorem, third law of thermodynamics and concept of residual entropy. Problems.

UNIT V

Chapter 10 - CHEMICAL KINETICS

11 HRS

Review of Chemical Kinetics: Mathematical characteristics of simple reactions, order and molecularity, zero order, first order, second order, half life. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Derivation of expression for rate constant for second order reaction i) when the concentrations of reactants are same ($a=b$) (ii) when the concentrations of reactants are not equal ($a \neq b$). Determination of the order of reaction – differential method, integration method, half-life period method and isolation method. Problems. Radioactive decay as a first order phenomenon.

Theories of Chemical Kinetics: Simple collision theory based on hard sphere model; mean free path, collision frequency, transition state theory – Steady state approximation (Equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Monomolecular reaction – Lindemann's hypothesis.

Study of reaction mechanism i) Acid hydrolysis of methyl acetate ii) hydrogen-iodine reaction.

REFERENCES:

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 46th Edition, Vishal Publishing Co. 2013.
2. Barrow G.M., Physical Chemistry, 5th Edition, Tata McGraw Hill, 2013.
3. Bahl B.S., Bahl A., Tuli G.D., Essentials of Physical Chemistry, S. Chand Publ., 2008.
4. Atkins P.W. and DePaula J., Physical Chemistry, 7th Edition, Oxford University Press, 2008.
5. Lee J.D., Concise Inorganic Chemistry, 5th Edition, Blackwell Publishing Co. 2013.
6. Atkins P.W. and Shriver, Inorganic Chemistry, Oxford University Press, 2012.
7. Huheey J.E., Keiter E.A., Keiter R.L. and Medhi O.K., Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edition, Pearson Publication, 2009.
8. Madan R.D., Sathyaprakash's Modern Inorganic Chemistry, 3rd Edition, S. Chand Publishing Co., 1987
9. Morrison R.T., Boyd R.N. and Bhattacharjee S.K., Organic Chemistry, 7th Edition, Pearson Publication., 2011.
10. Solomon G. And Fryhle C.B., Organic Chemistry, 10th Edition., Wiley Publication, 2014
11. Bahl B.S. and Bahl A., A Textbook of Organic Chemistry., S. Chand Publication., 2008.
12. Finar I.L., Organic Chemistry – Volume 1., Pearson Publishing Co., 2013
13. March J. And Smith M.B., Advanced Organic Chemistry, 6th Edition., Wiley Publishing Co. 2009.
14. Gurdeep Raj., Chemical Kinetics, GOEL Publishing House, 2002.

II B.SC., III SEMESTER, CHEMISTRY PRACTICAL – 3

DURATION: 3 HRS / WEEK

NO. OF UNITS: 15

1. Purification of organic solids and checking the purity by melting point
2. Purification of organic liquids and determination of boiling point
3. One stage preparations
 - a) Preparation of aspirin
 - b) Preparation of dibenzalacetone from benzaldehyde
 - c) Preparation of m- dinitrobenzene
 - d) Preparation of benzoic acid from toluene
4. Two stage preparation
 - a) Preparation of p-bromoaniline from acetanilide
 - b) Preparation of p-nitroaniline from acetanilide
 - c) Preparation of m-nitrobenzoic acid from methylbenzoate
 - d) Preparation of methyl orange
5. Organic Analysis
 - a) Test for aliphatic and aromatic compounds
 - b) Test for saturation and unsaturation
 - c) Detection of N, S and Halogens
 - d) Determination of physical constant
6. Kinetics
 - a. Velocity constant for the acid hydrolysis of methylacetate
 - b. Velocity constant for the saponification of ethylacetate (a = b method)

Repetition and Tests.

REFERENCES:

1. P.K.Mani&A.O.Thomas, Text Book of Practical Chemistry, 4th edition, 1976, Scientific Publications.
2. A.I.Vogel, Text Book of Practical Organic Chemistry 1998.
3. ArunSethi, Practical Organic Chemistry 1999.