

**B.Sc. 3<sup>rd</sup> SEMESTER**  
**DISCIPLINE SPECIFIC COURSE (CORE)**

**CH320C: CHEMISTRY**

**Course Weightage: 04 Credit (Theory)**

**Max. Marks: 60**

**No. of Contact Hours: 60**

**Course Objectives:**

*To introduce students to basic concepts of periodic table (d-block), chemistry of alcohols, phenol, ethers, thermodynamics and its applications to equilibria.*

**Course outcomes: The students after learning the course will be able to understand:**

1. *The trends in the chemical and physical properties of transition and inner transition elements along with their compounds.*
2. *The preparation and chemical reactions of alcohols, phenols and ethers.*
3. *Laws of thermodynamics and their application to chemical and phase equilibria.*

**UNIT I: Transition and Inner Transition Elements (15 Contact hours)**

**Transition elements:** Variable-oxidation states. Standard electrode Potentials of  $M^{2+}/M$  and  $M^{3+}/M^{2+}$  systems.

Ionic / Covalent and Acidic / Basic character of transition metal oxides in various oxidation states. Stabilization of unusual oxidation states.

Spectral and magnetic Properties; Calculation and uses of magnetic moment value.

Interstitial hydrides and oxides of first transition series: Preparation, properties & uses.

**Inner-Transition elements:** Electronic configuration, oxidation states, Magnetic properties and complexing behaviour of inner-transition elements.

Cause and consequences of Lanthanoid/Actinoid Contractions.

**Separation of lanthanoids:** Fractional crystallization, Ion-exchange and solvent extraction-methods.

**UNIT II: Chemistry of Oxygen Bearing Compounds-I (15 Contact hours)**

**Alcohols:** Classification, relative reactivity of 1<sup>o</sup>, 2<sup>o</sup>, 3<sup>o</sup> alcohols involving cleavage of C-O and O-H bonds. Reactions of alcohols: Esterification, alkylation, acetylation, dehydration, oxidation, reaction with thionyl chloride and Bouvaelt-Blanc-Reduction, Vicinal Diols: Oxidation by per-iodic acid and lead tetraacetate. Pinacol-Pinacolone rearrangement.

**Phenol:** Preparation of phenol from cumene. Acidity of phenol and effect of substituents on acidity. Mechanism of bromination of phenol, Kolbe-Schmidt reaction.

**Ethers:** Williamson's ether synthesis. Cleavage of ethers.

**Epoxides:** Preparation of epoxides. Mechanism of acid/base catalyzed ring openings of epoxides. Reactions of Grignard and organolithium reagents with epoxides.

**UNIT-III: Chemical Thermodynamics (15 Contact hours)**

**Thermodynamic functions:** State and path functions and their differentials. Heat capacity, heat capacities at constant volume and constant pressure and their relationship, Joule-Thomson effect, Calculation of  $w$ ,  $q$ ,  $\Delta U$  &  $\Delta H$  for the expansion of ideal gases under isothermal and adiabatic conditions. Kirchhoff's equation.

**Second law of thermodynamics:** Different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Concept of entropy, entropy as a function of V&T, and as a function of P&T. Clausius inequality; entropy as criteria for spontaneity and equilibrium. Entropy change in physical processes, ideal gas expansion and entropy of mixing of ideal gases.

**Third law of thermodynamics:** Gibbs function (G) and Helmholtz function (A) and spontaneity, Gibbs-Helmholtz equation, Variation of G and A with P, V and T. Nernst heat theorem, third law of thermodynamics.

#### **UNIT IV: Chemical and Phase Equilibria**

**(15 Contact hours)**

**Equilibrium:** Relationship between equilibrium constant and free energy change. Thermodynamic derivation of law of mass action. Clausius-Clapeyron equation, applications.

**Phase Equilibria:** Meaning of the terms: phase, component and degree of freedom, Phase rule. Phase diagrams of one component system – water and Sulphur systems.

**Phase equilibria of two component system:** Solid-liquid equilibria, simple eutectic system (Pb-Ag), desilverisation of lead.

Partially miscible liquids: Lower and upper consolute temperatures, (examples of phenol-water, trimethylamine-water, nicotine-water systems). Nernst distribution law and its applications

#### **Books Recommended:**

1. Concise Inorganic Chemistry; J.D. Lee; 5<sup>th</sup>Edn., OUP/Wiley India Pvt. Limited, 2008
2. Inorganic Chemistry: Principles of Structure and Reactivity; J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi; 4<sup>th</sup>Edn., Pearson Education India, 2006
3. Chemistry of the Elements; N. N. Greenwood, A. Earnshaw; 2<sup>nd</sup> Edn, Elsevier India, 2010.
4. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33<sup>rd</sup>Edn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017
5. Reaction Mechanism In Organic Chemistry (Revised Edition); Mukherji and Singh; 3<sup>rd</sup>Edn, Macmillan, 2007.
6. Organic Reactions and Their Mechanisms; P.S. Kalsi; 4<sup>th</sup>Edn, New Age Int. Pvt Ltd., 2017.
7. Advanced Organic Chemistry; J. Singh, L.D.S Yadav; 14<sup>th</sup>Edn, PragatiPrakashan, 2017.
8. Organic Chemistry; P.Y. Bruice; 8<sup>th</sup>Edn. Pearson Education, 2017.
9. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47<sup>th</sup>Edn, Vishal Pubs & Co, 2017.
10. Atkins' Physical Chemistry; P. Atkins, J. de Paula, J. Keeler; 11<sup>th</sup>Edn. Oxford University Press, 2018.
11. Physical Chemistry; T. Engel, P. Reid; 3<sup>rd</sup>Edn, Pearson India, 2013.
12. A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium (SI Units) - Vol. 2; K.L Kapoor; 6<sup>th</sup> Edn, McGraw Hill Education, 2019.

**CH320C: PRACTICALS**  
**Course Weightage: 02 Credit**

**Max. Marks: 30**  
**No. of Contact Hours: 60**

**Section A: Inorganic Chemistry**

1. **Qualitative Analysis:** To identify the given Inorganic mixture containing three acidic and three basic radicals (excluding insoluble and interfering radicals) by Macro Scale. Analysis (06 known and 06 unknown mixtures).
2. **Paper Chromatography:** Separation and identification of metal ions from mixtures containing two cations through ascending and radial methods. (03 exercises)

**Section B: Physical Chemistry**

1. Determination of water equivalent of Calorimeter.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of hydration of copper sulphate.

**Section C: Organic Chemistry**

1. Separation and Identification of binary mixtures of Organic Compounds using H<sub>2</sub>O, NaHCO<sub>3</sub> or NaOH.
2. **Organic Synthesis**
  - a) Aspirin via Acetylation of Salicylic acid
  - b) Iodoform from acetone.
  - c) p-bromoacetanilide from acetanilide.

**Books Recommended:**

1. Vogel's Qualitative Inorganic Analysis; G. Svehla; 7th Ed., Pearson Education. 2013.
2. Vogel's Textbook of Quantitative Inorganic Analysis; Bassett, G. H. Jeffery, J. Basset, J. Mendham, R. C. Denny, 6<sup>th</sup> ed., ELBS; 2007.
3. Advanced Practical Inorganic Chemistry; Gurdeep Raj; Krishna Prakashan Media (P) Ltd; 2013.
4. Vogel's Textbook of Practical Organic Chemistry; B.S. Furniss, A.J. Hannaford, P.W.G. Smith, & A.R., Tatchell; 5th Edn., Pearson India, 2003.
5. Practical Organic Chemistry; F.G. Mann, & B.C. Saunders; Orient-Longman, 1960.
6. Laboratory Manual in Organic Chemistry; R.K. Bansal; 5<sup>th</sup> Revised Edn., New Age International Limited, 2008.
7. Comprehensive Practical Organic Chemistry: Qualitative analysis Ahluwalia, V.K. & SunitaDhingra; Universities Press, India, 2004.
8. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; V. K. Ahluwalia, R. Aggarwal; Universities Press, India, 2000.
9. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3<sup>rd</sup>Edn; Vikas Publishing, 2009.
10. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media (P) Limited, 2015.
11. Senior Practical Physical Chemistry PB; B. D. Khosla; V. C. Garg; A. R. Gulati; R. Chand & Co, 2008.
12. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, PragatiPrakashan, 2008.
13. Inorganic Chemistry Practical; D. Pant, Bookrix, 2010.