

Chemistry – I (Semester 2)

Inorganic and Organic Chemistry

Course Objectives:

To introduce key concepts of chemical bonding, acid-base chemistry, and properties of p-block elements and application for qualitative and quantitative analysis of inorganic compounds during laboratory work.

Students will also learn the basic concepts of organic chemistry, chemistry of hydrocarbons and functional groups and the mechanism of organic reactions applied in qualitative analysis and synthesis of organic compounds.

PART-1 Inorganic Chemistry

Chemical Bonding:

Types of chemical bonding, ionic and covalent bonding, localized bond approach, theories of chemical bonding, valence bond theory (VBT), hybridization and resonance, prediction of molecular shapes using Valence Shell Electron Pair Repulsion (VSEPR) model, molecular orbital theory (MOT) applied to diatomic molecules, delocalized approach to bonding, bonding in electron deficient compounds, hydrogen bonding.

Acids and Bases:

Brief concepts of chemical equilibrium, acids and bases including soft and hard acids and bases (SHAB), concept of relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions, theory of indicators, solubility, solubility product, common ion effect and their industrial applications.

P-Block Elements:

Physical and chemical properties of p-block elements with emphasis on some representative compounds, inter-halogens, pseudo-halogens and polyhalides.

Lab.

Lab safety and good laboratory practices, knowledge about material safety data sheets (MSD), disposal of chemical waste and first-aid practices, qualitative analysis of salt mixtures, quantitative analysis, acid- base titrations, preparation and standardization of acid and alkali solutions, redox titrations, preparation and standardization of potassium permanganate solution and its use for the determination of purity of commercial potassium oxalate or oxalic acid, preparation and standardization of sodium thiosulfate solution and its use in determination of copper in a given sample, gravimetric analysis, determination of barium in a given sample, determination of chloride in a given solution.

PART-2: Organic Chemistry

Basic Concepts of Organic Chemistry:

Bonding and hybridization, localized and delocalized bonding, structure-aromaticity, inductive effect, dipole moment, resonance and its rules, hyperconjugation, classification and nomenclature of organic compounds including IUPAC system, types of organic reactions (an overview).

Chemistry of Hydrocarbons:

Saturated, unsaturated and aromatic hydrocarbons with emphasis on synthesis and free radical, electrophilic addition and electrophilic substitution reactions.

Chemistry of Functional Groups:

Hydroxyl, ether and amino groups, preparation and properties of alcohols, phenols, ethers, and amines with focus on reaction mechanism and applications, carbonyl compounds, preparations and reaction mechanism of aldehydes and ketones and their applications, carboxylic acids and their derivatives, acidity of carboxylic acids and effect of substituents on their acidity, preparation and reactions of carboxylic acids and their derivatives including esters, amides, acid halides and acid anhydrides.

Lab.

Qualitative analysis of compounds with different functional groups, synthesis of organic compounds using as a tool for understanding techniques like reflux, distillation, filtration, recrystallization and yield calculation, organic syntheses may include preparation of benzanilide from benzoyl chloride, succinic anhydride from succinic acid, phthalimide from phthalic anhydride, oximes and hydrazones from carbonyl compounds, and an ester from a carboxylic acid and alcohol etc.

Recommended Books (Part-1):

Catherine E. House crdft, & Alan G. S. (2008). *Inorganic Chemistry*, 3rd ed., Prentice Hall.

Chaudhary, S.U. (2013). *Ilmi Textbook of Inorganic Chemistry*, Ilmi Kitab Khana, Lahore.

Cotton, F.A. & Wilkinson, G. (2007). *Advanced Inorganic Chemistry*, 6th ed., John-Wiley & Sons, New York.

Hill, R. H. J.R & Fister, D.C. (2010). *Laboratory Safety for Chemistry Students*, John-Wiley & Sons, Inc..

House, J. E. (2008). *Inorganic Chemistry*. Academic Press. USA.

Huheey, J.E. (2006). *Inorganic Chemistry: Principles of Structure and Reactivity*, 3rd ed., Harper International SI Edition.

Huheey, J.E., Kieter E.A., & Keiter L.R. (1993). *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed., Benjamin-Cummings Pub Co.

- Kathleen A.H., & James E.H. (2010). *Descriptive Inorganic Chemistry*, 2nd ed., Brooks Cole.
- Lee, J. D. (1996). *Concise Inorganic Chemistry*, 5th ed., Chapman and Hall.
- Mendham, J., Denney, R.C., Barnes, J. D., Thomas, M. & Sivasankar, B. (2000). *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed., Pearson Education, Ltd..
- Miessler, G.L., & Tarr, D.A. (2008). *Inorganic Chemistry*, 3rd ed., Pearson Education, India.
- Sharpe, A.G. (1981). *Inorganic chemistry*, 3rd ed., Pearson Education India.
- Shriver, D.F., Atkins, P. W., & Langford, C.H. (1994). *Inorganic Chemistry*, 2nd ed., Oxford University Press.
- Svehla, G. (2009). *Vogel's Qualitative Inorganic Analysis*, 7th ed., (7th imp.), Pearson Education, Ltd.
- Wulfsberg G. (1991). *Principles of Descriptive Inorganic Chemistry*, 1st ed., University Science Books.

Recommended Books (Part-2):

- Brown, W. & Poon, T. (2005). *Introduction to Organic Chemistry*, 3rd ed., John-Wiley & Sons, Inc.
- Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (1989). *Vogel's Textbook of Practical Organic Chemistry*, 5th ed., Longman, UK.
- Gilbert, J. C. & Martin, S. F. (2010). *Experimental Organic Chemistry: A Miniscale and Microscale Approach*, 5th ed., Brooks/ Cole Cengage Learning.
- John, E. M. (2012). *Organic Chemistry*, 8th ed., Brooks/Cole Publishing Co, USA.
- Mayo, D. W., Pike, R. M. & Forbes, D. C. (2011). *Microscale Organic to Laboratory with Multistep and Multisacle Syntheses*, 5th ed., John-Wiley & Sons, Inc.
- Pavia, D. L., Kriz, G. S., Lampman, G. M. & Engel, R. G. (2013). *A Microscale Approach to Organic Laboratory Techniques*, 5th ed., Brooks/ Cole Cengage Learning.
- Robert, T. M. & Robert, N. B. (1992). *Organic Chemistry*, 6th ed., Prentice Hall, New Jersey.
- Solomons, T. W. G. & Fryhle, C. B. (2011). *Organic Chemistry*, 10th ed., John-Wiley & Sons, Inc.
- Sykes, P. (1986). *A Guide Book to Mechanism in Organic Chemistry*, 6th ed., Pearson Education Limited, England.
- Younus, M. (2006). *A Textbook of Organic Chemistry*, Ilmi Kitab Khana, Urdu Bazar, Lahore, Pakistan.