

**Government P G College, Ambala Cantt**  
**Course File (Session 2023-24)**  
**Name of Associate Professor: Dr. Deepak Sharma**  
**Class: BPSC/BLSC-I/2<sup>nd</sup> Semester**  
**Subject code and Name: B23-CHE-201/ CC-2/MCC-3/Chemistry II**

**SYLLABUS**

**Maximum Marks: 70**

**External: 50**

**Time: 3 hours**

**Internal: 20**

**Note:** The examiner is requested to set nine questions in all, selecting two questions from each section and one question i.e. Question No.1, based on entire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and nonprogrammable calculator is allowed.

**UNIT-I**

**Covalent Bond**

Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear ( $N_2$ ,  $O_2$ ) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond.

**Ionic Solids**

Ionic structures ( $NaCl$ ,  $CsCl$ ,  $ZnS$  (Zinc blende),  $CaF_2$ ) size effects, radius ratio rule and its limitations, Concept of Lattice energy, Born-Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarizability of ions, Fajan's Rule

**UNIT-II**

**Chemical Kinetics**

Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, Half-life period of a reaction, Arrhenius equation.

**Distribution Law**

Nernst distribution law its thermodynamic derivation, Nernst distribution law after association and dissociation of solute in one of the phases, of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride

**UNIT- III**

**Alkanes and Cycloalkanes**

Nomenclature, classification of carbon atoms in alkanes and its structure. Isomerism in alkanes, sources. Methods of formation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation

of alkanes: reactivity and selectivity. Nomenclature of Cycloalkanes, Baeyer's strain theory and its limitations, theory of strainless rings.

### **Alkenes**

Nomenclature of alkenes and its structure. Methods of formation: dehydration of alcohols, dehydrohalogenation of alkyl halide, Hofmann elimination and their mechanism. The Saytzeff rule and relative stabilities of alkenes. Chemical reactions: electrophilic and free radical additions, addition of halogens, halogen acids, hydroboration oxidation, oxymercuration-reduction, ozonolysis and hydration. Markownikoff's rule of addition

## **UNIT-IV**

### **Hydrogen Bonding and Van der Waals forces**

Hydrogen Bonding- Definition, types, effects of hydrogen bonding on properties of substances, application Brief discussion of various types of Van der Waals forces.

### **Metallic Bond and semiconductors**

Metallic bond Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors Introduction, types, and applications.

### **Text Books:**

1. Jauhar, S.P.; Modern Approach to Inorganic Chemistry, Vol I, Modern Publishers
2. Sehgal, J.M.; Modern Approach to Organic Chemistry, Vol I, Modern Publishers
3. Dhawan, S.N.; Pradeep's Organic Chemistry, Vol I, Pradeep Publications
4. Kiran, S.; Kavya; Modern Approach to Physical Chemistry, Vol I, Modern Publishers
7. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6th Edition, McGraw Hill Education.
8. Bhasin K.K.; Pradeep's Inorganic Chemistry, Vol I, Pradeep Publications
9. Kheterpal, S.C.; Pradeep's Physical Chemistry, Vol II, Pradeep Publications

### **Reference Books:**

1. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
2. Clayden, J.; Greeves, N.; Warren, S. (2012), Organic Chemistry, Oxford.
3. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.
5. Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press.

## **COURSE OBJECTIVES**

**The Course Objectives are given below**

- To study the shapes of molecule and ions on the basis of various theories and hybridization.
- To study the shape and characteristics of various types of orbitals such as atomic, molecular and hybrid orbitals.
- To study the effect of different types of electron in distortion of shape of molecule and ions.
- To have better understanding MOT and explanation of various concepts on the basis of it.
- To study the ionic structure of solids, lattice energy, salvation energy.
- To learn polarization and polarizability.
- To learn the rate of reaction and various factors determining the rate of reaction.
- To have the knowledge of distribution law.
- To learn methods of formation and properties of alkanes, cycloalkanes and alkenes.
- To learn various weak interactions, bonding in metals.

## **COURSE OUTCOMES**

**After the successful completion of the course, students will be able:**

- To distinct various types of orbitals such as atomic, molecular and hybrid orbitals.
- To understand and can explain the distortion in shape of molecule and ion .
- To apply different types of theories related to bonding in order to explain the observed characteristics of molecules and ions.
- To understand and can justify as well as calculate the percentage ionic character in covalent molecules.
- To compare various theories related to bonding.
- To calculate lattice energy of solids, rate and order of reactions.
- To give the nomenclature of organic compounds related to class of alkanes, cycloalkanes and alkenes.
- To depicts the mechanism of various organic reactions.
- To explain the stereochemical aspects of the chemical reactions.
- To explain reactivity-selectivity, regioselectivity and stereospecificity.
- To differentiate conductors, insulators, semiconductors.
- To understand the application of semiconductors.

## LESSON PLAN

Week No	Scheduled Dates	Topics to be covered
<b>1</b>	<b>Feb 19, 2024-</b> Feb 21, 2024	Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction
<b>2</b>	<b>Feb 26, 2024-</b> Feb 28, 2024	integrated rate expression for zero, first, Half-life period of a reaction, Arrhenius equation.
<b>3</b>	<b>Mar 04, 2024-</b> Mar 06, 2024	Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements
<b>4</b>	<b>Mar 11, 2024-</b> Mar 13, 2024	Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements
<b>5</b>	<b>Mar 18, 2024-</b> Mar 19, 2024	Molecularorbital theory of homonuclear (N <sub>2</sub> , O <sub>2</sub> ) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond
<b>6</b>	<b>Apr 01, 2024-</b> Apr 03, 2024	Nomenclature, classification of carbon atoms in alkanes and itsstructure. Isomerism in alkanes, sources. Methods of formation: Wurtz reaction, Kolbe reaction, Corey- House reaction and decarboxylation of carboxylic acids.
<b>7</b>	<b>Apr 08, 2024-</b> Apr 10, 2024	physicalproperties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity. Nomenclature of Cycloalkanes, Baeyer' s strain theory and its limitations, theory of strainless rings.
<b>8</b>	<b>Apr 15, 2024-</b> Apr 17, 2024	Nomenclature of alkenes and its structure. Methods of formation: dehydration of alcohols, dehydrohalogenation of alkyl halide, Hofmann elimination and their mechanism.
<b>9</b>	<b>Apr 22, 2024-</b> Apr 24, 2024	The Saytzeff rule and relative stabilities of alkenes. Chemical reactions: electrophilic and free radical additions, addition of halogens, halogen acids, hydroboration oxidation, oxymercuration-reduction, ozonolysis and hydration. Markownikoff's rule of addition
<b>10</b>	<b>Apr 29, 2024-</b> May 01, 2024	Ionic structures (NaCl, CsCl, ZnS (Zinc blende), CaF <sub>2</sub> ) size effects, radius ratio rule and its limitations, Concept of Lattice energy, Born- Haber cycle
<b>11</b>	<b>May 06, 2024-</b> May 08, 2024	Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarizability of ions, Fajan's Rule

<b>12</b>	<b>May 13, 2024-</b> May 15, 2024	Nernst distribution law its thermodynamic derivation, Nernst distribution law after association and dissociation of solute in one of the phases
<b>13</b>	<b>May 20, 2024-</b> May 22, 2024	Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride
<b>14</b>	<b>May 27, 2024-</b> May 29, 2024	Hydrogen Bonding and Van der Waals forces Hydrogen Bonding Definition, types, effects of hydrogen bonding on properties of substances
<b>15</b>	<b>Jun 03, 2024-</b> Jun 05, 2024	Brief discussion of various types of Van der Waals forces. Metallic Bond and semiconductors Metallic bond Qualitative idea of valence bond and Band theories of metallic bond
<b>16</b>	<b>Jun 10, 2024-</b> Jun 12, 2024	(conductors, semiconductors, insulators). Semiconductors Introduction, types, and applications.