

# **UG SYLLABUS UNDER SEMESTER SYSTEM**

## **CHEMISTRY CORE PROGRAMME**

**FIRST AND SECOND SEMESTER**

**[Effective from July 2015]**



**DEPARTMENT OF CHEMISTRY  
NORTH LAKHIMPUR COLLEGE  
(AUTONOMOUS)**

**P.O. KHELMATI, NORTH LAKHIMPUR, 787 031**

---

**Modified distribution of marks to be implemented from 1/7/2015**

Semester –I & II: Total credits 5 (Each)

Total marks: 100 (75 from semester exam+ 25 from I.A)

<b>Semester</b>	<b>Paper</b>	<b>Titles/ Contents</b>	<b>Marks</b>	<b>Total Marks</b>	<b>Credits</b>
Semester-I	CT-5-CHE-101	1.Inorganic 2.Organic 3.Physical	25 25 25	75	5 [IA included]
Semester-II	CT-5-CHE-202	1.Inorganic 2.Organic 3.Physical	25 25 25	75	5 [IA included]

**FIRST SEMESTER**  
**CHEMISTRY CORE PROGRAMME**  
**NORTH LAKHIMPUR COLLEGE (AUTONOMOUS)**  
**TOTAL CREDIT: 5 [L=112]**  
**Paper Code: CT-5-CHE-101**  
*Title: General Chemistry [A]*

**Section I Inorganic Chemistry**

(L- 39, Marks: 25)

**UNIT – I:**

**Periodic properties:** - Effective nuclear charge (screening constant – Slater’s rule only), ionic, and covalent radii, ionization potential, electron affinity and electro negativity, (Pauling, Mullikan’s and Allred-Rochow scales). **Marks**

= 7

**UNIT – II:**

**Bonding and structure:** Electrovalent bond, covalent bond, covalent ionic resonance and partial ionic character in covalent bonds, lattice energy, bond length, bond angle and bond energy. VB and MO theories, LCAO and MO diagram of homo and hetero diatomic molecules, VSEPR theory and its applications. **Marks =13**

**UNIT – III:**

**Chemistry of d- and f- block elements:**

Electronic structure, oxidation state, ionic radii, Lanthanide and Actinide contraction and separation of lanthanides

**Marks = 5**

**Section -II Organic Chemistry-I**

(L- 39, Marks: 25)

**Unit-I**

**Basics of Organic chemistry**

Importance of Organic Chemistry and Organic systems to human beings and society.

**Organic Compounds:** Natural Sources, classification and Nomenclature.

**Hybridization:** Shape of molecules, Influence of hybridization on bond properties.

**Electronic displacements:** Inductive, Electromeric, Resonance, Mesomeric effects and Hyper conjugation and their applications. Dipole moment.

**Organic acids and bases:** Their relative strength, hard and soft Acids and Bases.

Homolytic and Heterolytic fission, Electrophiles and Nucleophiles: Nucleophilicity and basicity.

**Reactive intermediates:** Carbocations, Carbanions, free radicals, Carbenes, nitrenes-Benzynes types, Shape and their relative Stability.

Energy profile diagrams of one step, two steps and three steps reactions, Rate limiting steps. Activation Energy. Kinetically and thermodynamically controlled reactions.

**Marks =15**

## **Unit –II**

### **Stereochemistry**

Elements of symmetry and their application in simple organic molecules. Definition and classification of stereoisomerism, Representation of organic molecules in three & two dimension: Fischer Projection, Newman projection, Saw horse and flying wedge projection formula and their interconversions.

**Optical isomerism:** Concepts of asymmetry, dissymmetry, optical activity, Specific rotation, Chirality, enantiomers, Diastereomers, racemic mixture, racemization and Resolution, Threo and Erythro forms, Meso structures & Epimers.

**Relative and absolute configuration:** D/L and R/S designations. Walden inversion and asymmetric synthesis.

**Geometrical Isomerism:** Restricted rotation about C=C bonds, physical and chemical properties of diastereoisomers, determination of configuration of geometrical isomers: cis-trans isomerism, syn-anti and E/Z notation with CIP rules. Geometrical isomerism in oximes and alicyclic compounds.

**Marks 10**

## **Section III Physical Chemistry (Major)**

**(L- 34, Marks: 25)**

### **Unit I- Gas**

Derivation of kinetic gas equation, Maxwell distribution of molecular speed, different types of average speeds, collision properties, Mean free path, determination of collision diameter, transport phenomenon in gases-viscosity, coefficient of viscosity, law of equipartition of energy, degrees of freedom and average energy of a molecule, molecular basis of heat capacity, barometric formula, and its uses for determination of Avogadro number.

Deviation from ideal behavior, vander Waals and Dieterici's, Virial equation of state, Boyle's temperature, Critical constants, reduced equation of state, co-efficient of compressibility and thermal expansion.

**Marks: 13**

### **Unit II- Liquid**

Physical properties of liquids - vapour pressure, surface tension, viscosity, Parachor-determination and application, liquid crystals.

**Marks: 4**

### **Unit III – Solids**

Basic laws of crystallography, crystal system, crystal lattice, Miller indices, and simple face centered and body centered cubic lattice, number of points in a unit cell.

X-Ray diffraction study of crystals, Bragg's law, determination of crystal structure- Rotating crystal method, powder method, crystal structure of NaCl and KCl, packing of crystals, closed packed structure, crystal defect-point defects, conductors, semiconductors and insulators from band theory.

**Marks: 8**

### **Inorganic Chemistry Text Books:**

1. Basic Inorganic Chemistry – Cotton and Wilkinson
2. Inorganic Chemistry – J.D. Lee
3. Inorganic Chemistry – Huhey
4. Advanced Inorganic Chemistry – R.D. Madan
5. Inorganic Chemistry – Shriver & Alkins

### **Inorganic Chemistry Ref. Books:**

1. Selected Topics in Inorganic chemistry – Malik, Tuli and Madan
2. Basolo F and Pearson R.C., Mechanism of Inorganic chemistry – John Wiley & Sons.

### **Physical Chemistry Text Books**

1. P.W. Atkins, Physical Chemistry, Oxford University Press
2. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India) Ltd., New Delhi
3. P.C. Rakshit, Physical Chemistry - Science Book Agency, Kolkata

### **Physical Ref. Books:**

1. Physical Chemistry – B.R. Puri, L.R. Sharma, Madan S. Pathania, Shobanlal Nagin, Chand & Co.
2. Advanced Physical Chemistry – J.N. Gurta & H. Snehi, Pragati Prakashan.

### **Organic Chemistry Text Books,**

- 1) Organic Chemistry: I.L. Finers, Vol. I & II ELBS
- 2) Organic Chemistry Morrison and R.N. Boyd
- 3) Advanced Organic Chemistry: Reaction Mechanism & Structure – Jerry March Wiley Eastern.
- 4) P.S. Kalsi Textbook of Organic Chemistry

### **Organic Chemistry Ref. Books:**

- 1) A Guide book to Mechanism in Organic Chemistry, P. Sykes, McGraw Hill
- 2) Organic Chemistry, Bruice, Pearson Education
- 3) Advanced Organic Chemistry - B.S. Bahl and A. Bahl
- 4) Organic reaction mechanism – R.K. Bansal, Tata McGraw Hill
- 5) Advanced General Organic Chemistry – S.C. Ghosh

**SECOND SEMESTER**  
**CHEMISTRY CORE PROGRAMME**  
**NORTH LAKHIMPUR COLLEGE (Autonomous)**  
**TOTAL CREDIT: 5 [L-112]**  
**Paper Code: CT-5-CHE-201**  
*Title: General Chemistry [B]*

**Section I: Inorganic Chemistry**

**(L- 34, Marks: 25)**

**Unit I: Non Transition elements:** Electronic structure, general properties and comparative study of group of non transition elements.

- a) Noble Gas : Compounds of Xenon only
- b) **Boron:** Wade's rule, Nomenclature of closo, nido and arachno boranes, structure of boron hydrides ( $B_2H_6$ ), metalborane and metallocarboranes. Borazine, phosphazine,  $S_4N_4$ ,  $(SN)_x$  – preparation, structure and use.
- c) Carbon : Fullerenes ( $C_{60}$ )
- d) **Silicon:** Silicones, classifications and structure of silicates. Zeolites, use of Zeolites as catalyst and molecular sieve, aluminosilicates.
- e) **Nitrogen:** Hydrazine, hydroxylamine and hydrazoic acid.
- f) **Phosphorus;** Phosphines, oxy acids of phosphorus, organo phosphorus compounds.

**Marks 15**

**Unit II: Metals**

Theory of reduction (Thermodynamic approach), role of carbon and other reducing agents, electrolytic reduction, roasting and calcinations.

Method of purification and refining of metals including modern methods like zone refining, vacuum arc process, ion exchange, solvent extraction and electrolytic method, Van – Arkel process and hydrometallurgy.

**Extraction of metals:** Cr from chromite, Mo from molybdenite, W from wolframite, Mn from pyrolusite and V from carnotite

**Marks= 10**

**Section –II Organic Chemistry**

**(L- 39, Marks: 25)**

**Unit –I**

**a) Carbon- Carbon sigma bonds**

Chemistry of Alkanes: Formation of Alkanes with special emphasis on **Corey House** Synthesis, **Wurtz** Reaction, **Wurtz-Fittig**, Reactions, of Alkanes. Free Radical substitution-Halogenations-relative reactivities and selectivity

**Marks -4**

**b) Carbon-Carbon pi bonds**

Formation of alkenes and alkynes by Elimination: Mechanism  $E1$ .,  $E2$ ,  $E1cB$  reactions. Saytzeff and Hoffmann Elimination, special emphasis on preparation of alkenes by syn

elimination-pyrolysis of esters, **Chugaev, Wittig, Heck, Peterson reaction.**

**Reaction of alkenes: Addition Reaction-** Electrophilic and free radical additions, their Mechanisms. (Markonikoff/ Anti Markonikoff addition) regioselectivity (directional selectivity), and stereoselective of addition reactions. Mechanism of oxymercuration – demercuration, Hydroboration-Oxidation, Ozonolysis, reduction (catalytic and chemical) **syn. and Anti hydroxylation** (oxidation), simple effect of stereo selectivity and stereo specificity.

**Reactions of Alkynes:** Acidity, Electrophilic and Nucleophilic additions, Hydration to form carbonyl compounds. Alkylation of terminal alkynes.

**Conjugated Alkenes/Alkynes: 1, 2 and 1, 4 addition reactions, Diels-Alder reaction.**

**Marks -8**

## **Unit -II**

**Cycloalkanes and conformational analysis:**

Synthesis and reactions of three, four, five and six membered Cycloalkanes, Their relative stability, Bayer strain theory. Sahe-Mohr theory.

**Conformational analysis of Alkanes:** (ethane & butane) Relative stability, Energy diagram

**Cyclohexane:** Chair, Boat and Twist boat forms, Relative stability with energy diagram axial and equatorial bonds including perspective representation and Newman projections. Conformation & conformational analysis of monosubstituted Cyclohexane derivative

**Marks-7**

## **Unit-III**

### **Aromatic Hydrocarbons**

Aromaticity: Huckel's rule, aromatic characters of arenes, benzenoid, non-benzenoid-aromatic compounds and heterocyclic and polynuclear hydrocarbons with suitable examples. Antiaromaticity and nonaromaticity structure and stability of benzene Preparation, Properties and reactions of Toluene, Xylene, Mesitylene, Styrene.

**Electrophilic Aromatic Substitution:** Halogenation, nitration, sulphonation and Friedel-craft's alkylation / acylation with their mechanism. Activation / deactivation of aromatic ring and directing effects of groups. Partial rate factor (O/P ratio)

**Marks-6**

## **Section-III II Physical Chemistry**

**(L- 39, Marks: 25)**

### **Unit 1- Chemical Thermodynamics -I**

Extensive and intensive properties of a system, thermodynamic processes: cyclic, reversible, irreversible processes, thermodynamic function, complete differential, Zeroth law of thermodynamics.

First law of thermodynamics-internal energy, enthalpy, molar heat capacities, relation between  $C_p$  and  $C_v$ , work of expansion in reversible and irreversible process, adiabatic process, relation between P, V, T.

Variation in internal energy and enthalpy with temperature, Joule Thomson effect, calculation of Joule Thomson co-efficient for ideal and Vander Waal's gas.

Thermo chemistry- Hess's law, Kirchhoff's law relation of reaction enthalpy with internal

energy, Bond energy and Bond dissociation energy, calculation from thermochemical data.

**Marks: 10**

### **Unit II – Chemical Thermodynamics II**

Second law of thermodynamics, Carnot's theorem, Carnot cycle, efficiency of heat engines, thermodynamic scale of temperature, concept of entropy, entropy change in a cyclic, reversible, irreversible processes, calculation of entropy changes of an ideal gas with change in P, V, T, entropy change in physical transformation, entropy of mixing. Helmholtz free energy (A) and Gibb's free energy (G), variation of A and G with P, V, T, criteria for spontaneity and equilibrium, Maxwell's relationship, Gibb's –Helmholtz equation. Nernst heat theorem, consequence of the theorem, third law of thermodynamics, and its verification. Determination of absolute entropies of pure substance

**Marks: 10**

### **Unit III- System of Variable Composition and Chemical Equilibrium**

Partial molar quantities-chemical potential, Gibb's- Duhem equation, effect of temperature and pressure on chemical potential, Duhem-Margules equation, concept of activity and activity coefficient, fugacity, derivation of expression of equilibrium constant, temperature pressure and concentration dependence of equilibrium constant-Van't Hoff equation, Le-Chatelier principle (qualitative treatment) .

**Marks: 5**

#### **Inorganic Chemistry Text Books:**

1. Basic Inorganic Chemistry – Cotton and Wilkinson
2. Inorganic Chemistry – J.D. Lee
3. Inorganic Chemistry – Huhey
4. Advanced Inorganic Chemistry – R.D. Madan
5. Inorganic Chemistry – Shriver & Alkins

#### **Inorganic Chemistry Ref. Books:**

1. Selected Topics in Inorganic chemistry – Malik, Tuli and Madan
2. Basolo F and Pearson R.C., Mechanism of Inorganic chemistry – John Wiley & Sons.

#### **Physical Chemistry Text Books**

1. P.W. Atkins, Physical Chemistry, Oxford University Press
2. Physical Chemistry Vols. I, II, III and IV – K.L. Kapoor, MacMillan (India), Ltd., New Delhi
3. P.C. Rakshit, Physical Chemistry - Science Book Agency, Kolkata

#### **Physical Ref. Books:**

1. Physical Chemistry – B.R. Puri, L.R. Sharma, Madan S. Pathania, Shobanlal Nagin, Chand & Co.
2. Advanced Physical Chemistry – J.N. Gurta & H. Snehi, Pragati Prakashan.

#### **Organic Chemistry Text Books,**

- 1) Organic Chemistry: I.L. Finers, Vol. I & II ELBS
- 2) Organic Chemistry Morrison and R.N. Boyd
- 3) Advanced Organic Chemistry: Reaction Mechanism & Structure – Jerry March Wiley Eastern.
- 4) P.S. Kalsi Textbook of Organic Chemistry

#### **Organic Chemistry Ref. Books:**

- 1) A Guide book to Mechanism in Organic Chemistry, P. Sykes, McGraw Hill



- 2) Organic Chemistry, Bruice, Pearson Education
- 3) Advanced Organic Chemistry - B.S. Bahl and A. Bahl
- 4) Organic reaction mechanism – R.K. Bansal, Tata McGraw Hill
- 5) Advanced General Organic Chemistry – S.C. Ghosh