**UGC CBCS**

**UG COURSE CURRICULUM**

**AND**

**SYLLABI**

**(As per UGC’s Draft Model**

**Syllabi)**

**(PROPOSED SCHEME)**

**CHEMISTRY**

**UGC’s Draft Model Syllabi)**

**(PROPOSED SC**

**HEME)**

***NORTH LAKHIMPUR COLLEGE***

***(AUTONOMOUS)***

SYLLABUS

FOR

UNDER GRADUATE (UG) COURSE

IN

CHEMISTRY

(GENERIC ELECTIVE)

UND ER

CHOICE BASED CREDIT SYSTEM

NORTH LAKHIMPUR COLLEGE

2019

**CBCS**

**UG - SY LLABI**

**CHEMISTRY**

**(GENERIC ELECTIVE)**

CHEMISTRY

**(1st Semester)**

Course Code: **CHE-GE-T4-101**

*Atomic Structure, Bonding,*

*General Organic Chemistry and Aliphatic Hydrocarbons*

**(Contact Hours-60; Credits: 04)**

**Full Marks = 70 [**End Semester Exam (56) Internal Assessment (14)]

**Section A:- 28 Marks and Section B:- 28 Marks**

***Section A: Inorganic Chemistry***

**Unit I: Atomic Structure**

Review of: Bohr’s theory and its limitations, dual behaviour of matter and radiation, de-Broglie’s relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of Ψ and Ψ 2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m*l* and m*s*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m*s*).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability

of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of

atomic orbitals, Anomalous electronic configurations.

**14 Lectures, Marks - 13**

**Unit II: Chemical Bonding and Molecular Structure**

*Ionic Bonding*: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan’s rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

*Covalent bonding*: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.Concept of resonance and resonating structures in various inorganic and organic compounds.

*MO Approach*: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

**16 Lectures, Marks - 15**

***Section B: Organic Chemistry***

**Unit III: Fundamentals of Organic Chemistry**

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance

and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting *p*K values. Aromaticity: Benzenoids and Hückel’s rule.

**8 Lectures, Marks - 6**

**Unit IV: Stereochemistry**

Conformation with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso Compounds. Threo and erythro; D and L; Cis-trans nomenclature; cIP Rules: R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C=C systems)

**10 Lectures, Marks - 10**

**Unit V: Aliphatic Hydrocarbons**

**Alkanes**: (Up to 5 Carbons):

*Preparation*: Catalytic hydrogenation, Wurtz reaction, Kolbe’s synthesis, from Grignard reagent.

*Reactions*: Free radical Substitution: Halogenation.

**Alkenes:** (Up to 5 Carbons):

*Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff’s rule).

*Reactions*: cis-addition (*alk*. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff’s and anti Markownikoff’s addition), Hydration, Ozonolysis.

**Alkynes:** (Up to 5 Carbons):

*Preparation*: Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides.

*Reactions*: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.

**12 Lectures, Marks - 12**

**Reference Books:**

**1.** J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.

**2.** F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.

**3.** Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.

**4.** James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.

**5.** T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.

**6.** Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.

**7.** E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.

**8.** I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.

**9.** R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.

**10.** Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand

CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(1st Semester)**

Course Code: **CHE-GE-P2-101**

**(Contact Hours-60; Credits: 02)**

**Full Marks = 30**

Time- 6hours

**1. *Section A: Inorganic Volumetric Analysis*: (*any one*) Marks - 13**

***i*.** Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.

***ii*. Estimation of oxalic acid by titrating it with KMnO4.**

***iii*.** Estimation of water of crystallization in Mohr’s salt by titrating with KMnO4.

***iv*.** Estimation of Fe (II) ions by titrating it with KMnO4.

***v*.** Estimation of Cu (II) ions iodometrically using Na2S2O3.

**2. *Section B: Organic Chemistry*: (*any one*) 12 Marks - 13**

***i*. Detection of characterized element (N, S, Cl, Br, I) in an organic compound.**

***ii*.** Separation of mixtures by Chromatography: Measure the R*f* value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

**3. Viva - voce Marks - 4**

**Reference Books:**

**1.** Vogel’s Qualitative Inorganic Analysis, A. I. Vogel, Prentice Hall, 7th Ed.

**2.** Vogel’s Quantitative Chemical Analysis, A. I. Vogel, Prentice Hall, 6th Ed.

**3.** Textbook of Practical Organic Chemistry, A. I. Vogel, Prentice Hall, 5th Ed.

**4.** Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960 CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(2nd Semester)**

Course Code: **CHE-GE-T4-201**

*Chemical Energetics, Equilibria and*

*Functional Organic Chemistry*

**(Contact Hours-60; Credits: 04)**

**Full Marks = 70 [**End Semester Exam (56) Internal Assessment (14)]

**Section A:- 28 Marks and Section B:- 28 Marks**

***Section A: Physical Chemistry***

**Unit I: Chemical Energetics**

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature– Kirchhoff’s equation.

**10 Lectures, Marks - 10**

**Unit II: Chemical Equilibrium**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between Δ*G* and Δ*Go*, Le Chatelier’s principle. Relationships between *Kp*, *Kc* and *Kx* for reactions involving ideal gases.

**8 Lectures, Marks - 6**

**Unit III: Ionic Equilibria**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

**12 Lectures, Marks - 12**

**Section *B: Organic Chemistry***

**Unit IV: Aromatic Hydrocarbons**

Preparation: (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft’s reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

**8 Lectures, Marks - 8**

**Unit V: Alkyl and Aryl Halides**

*Alkyl Halides*: (Up to 5 Carbons): Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson’s ether synthesis: Elimination vs substitution.

*Aryl Halides*: *Preparation*: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions* (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3

(or NaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

**8 Lectures, Marks - 8**

**Unit VI: Alcohols, Phenols and Ethers** (Up to 5 Carbons)

*Alcohols*: Preparation: Preparation of 1о, 2о and 3о alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, *alk*. KMnO4, acidic dichromate, conc. HNO3). Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

*Phenols*: (Phenol case): Preparation: Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Schotten – Baumann Reaction.

*Ethers (aliphatic and aromatic):* Cleavage of ethers with HI.

*Aldehydes and ketones (aliphatic and aromatic):* (Formaldehye, acetaldehyde, acetone and benzaldehyde): Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro’s Reaction, Wittig Reaction, Benzoin Condensation. Clemensen Reduction and Wolff Kishner

Reduction. Meerwein-Pondorff Verley Reduction.

**14 Lectures, Marks – 12**

**Reference Books:**

**1.** I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.

**2.** R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.

**3.** Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

**4.** G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).

**5.** G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).

**6.** R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

**7.** Ball, D. W. Physical Chemistry Thomson Press, India (2007).

**8.** Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(2nd Semester)**

Course Code: **CHE-GE-P2-201**

**(Contact Hours-60; Credits: 02)**

**Full Marks = 30 [**End Semester Exam (24) Internal Assessment (6)]

Time- 6hours

**1. *Section A: Physical Chemistry*: (*any one*) *M*arks - 10**

**Thermochemistry and Ionic equilibria**

***i*.** Determination of heat capacity of calorimeter for different volumes.

***ii*.** Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

***iii*.** Determination of enthalpy of ionization of acetic acid.

***iv*.** Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).

***v*.** Determination of enthalpy of hydration of copper sulphate.

***vi*.** Study of the solubility of benzoic acid in water and determination of ΔH.

***vii.*** *Measurement of pH* of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

***ix.*** *Preparation of buffer solutions*:

**(*a*)** Sodium acetate-acetic acid or,

**(*b*)** Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

**2. *Section B: Organic Chemistry*:** (**either** *i*. + *iii*. **or** *ii*. + *iii***.) Marks - 3+7=*10***

***i*.** *Purification* of organic compounds by crystallization (from water and alcohol) and

distillation.

***ii*.** *Criteria of Purity*: Determination of melting and boiling points.

***iii*.** *Preparations*: Mechanism of various reactions involved to be discussed.

Recrystallisation, determination of melting point and calculation of quantitative yields to

be done.

(a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

(c) Oxime and 2, 4-dinitrophenylhydrazone of aldehyde/ketone

**3. Viva - voce Marks - 4**

**Reference Book:**

**1.** A. I. Vogel: Textbook of Practical Organic Chemistry, 5th Ed. Prentice-Hall.

**2.** F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).

**3.** B. D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co. CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(3rd Semester)**

Course Code: **CHE-GE-T4-301**

*Solutions, Phase Equilibrium, Conductance, Electrochemistry and*

*Functional Group Organic Chemistry-II*

**(Contact Hours-60; Credits: 04)**

**Full Marks = 70 [**End Semester Exam (56) Internal Assessment (14)]

**Section A:- 28 Marks and Section B:- 28 Marks**

***Section A: Physical Chemistry***

**Unit I: Solutions**

Thermodynamics of ideal solutions: Ideal solutions and Raoult’s law, deviations from Raoult’s law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Azeotropes. artial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

**8 Lectures, Marks - 8**

**Unit II: Phase Equilibrium**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic deviation. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points ( lead –silver, FeCl3-H2O and Na-K only)

**8 Lectures, Marks - 6**

**Unit III: Conductance**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch’s law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only cidbase).

**6 Lectures, Marks - 6**

**Unit IV**: **Electrochemistry**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. PH determination using hydrogen electrode and quinhydrone electrode.

**8 Lectures, Marks - 8**

***Section B: Organic Chemistry***

**Unit V: Carboxylic acids and their derivatives**

*Carboxylic*

*acids (aliphatic and aromatic)*: Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction. *Carboxylic acid derivatives aliphatic): (upto 5 carbons)* Preparation: Acid chlorides, anhydrides, Esters and Amides from acids and their interconversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin Condensation.

**6 Lectures, Marks - 6**

**Unit VI: Amines and Diazonium Salts**

*Amines (Aliphatic and Aromatic)*: (Up to 5 carbons): Preparation: from alkyl halides, Gabriel’s Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

*Diazonium salts*: Preparation: from aromatic amines. Reactions: conversion to benzene,

phenol, dyes

**6 Lectures, Marks - 6**

**Unit VII: Carbohydrates**

*Carbohydrates*: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides.

**8 Lectures, Marks - 8**

**Unit VIII: Amino Acids, Peptides and Proteins**

*Preparation of Amino Acids*: Strecker synthesis using Gabriel’s phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. *Reactions of Amino acids*: ester of –COOH group, acetylation of –NH2 group, complexation with Cu2+ ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

**10 Lectures, Marks - 8**

**Reference Books:**

**1.** G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).

**2.** G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004).

**3.** J. C. Kotz, P. M. Treichel, J. R. Townsend, General Chemistry, Cengage

**4.** Learning India Pvt. Ltd.: New Delhi (2009).

**5.** B. H. Mahan: University Chemistry, 3rd Edn. Narosa (1998).

**6.** R. H. Petrucci, General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).

**7.** Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

**8.** Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

**9.** Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

**10.** Nelson, D. L. & Cox, M. M. Lehninger’s Principles of Biochemistry 7th Ed., W. H Freeman.

**11.** Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman.

CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(3rd Semester)**

Course Code: **CHE-GE-P2-301**

**(Contact Hours-60; Credits: 02)**

**Full Marks = 30 [**End Semester Exam (24) Internal Assessment (6)]

Time- 6hours

**1. *Section A: Physical Chemistry*: (*any one*) Marks - 10**

**Phase Equilibria and conductance**

***i*.** Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

***ii*.** Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

***iii*.** Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

***iv.*** Determination of cell constant

***v.*** Perform the following conductometric titrations:

***a*.** Strong acid vs. strong base or,

***b*.** Weak acid vs. strong base

**2. *Section B: Organic Chemistry*: (*any one*) Marks - 10**

Systematic Qualitative Organic Analysis of Organic Compounds possessing mono-functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

**3. Viva – voce Marks - 4**

**Reference Books:**

**1.** A. I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Ed.

**2.** F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.

**3.** B. D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.

**4.** Ahluwalia, V. K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(4th Semester)**

Course Code: **CHE-GE-T4-401**

*Transition metals, Coordination Chemistry,*

*States of Matter and Chemical Kinetics*

**(Contact Hours-60; Credits: 04)**

**Full Marks = 70 [**End Semester Exam (56) Internal Assessment (14)]

**Section A:- 28 Marks and Section B:- 28 Marks**

***Section A: Inorganic Chemistry***

**Unit I: *Transition Series* Elements (*3d* series)**

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

*Lanthanoids and actinoids*: Electronic configurations, oxidation states, colour, magnetic

properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

**12 Lectures, Marks - 10**

**Unit II: *Coordination Chemistry***

*Valence Bond Theory (VBT)*: Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC (2005) system of nomenclature.

**8 Lectures, Marks - 8**

**Unit III: Crystal Field Theory**

*Crystal Field Theory (CFT)*: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

**10 Lectures, Marks - 10**

***Section B: Physical Chemistry***

**Unit IV: Kinetic Theory of Gases**

*Gases*: Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases and derivation of the

kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required).

Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO2. Maxwell Boltzmann distribution laws of molecular velocities and

molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square

velocities (no derivation). Collision number and mean free path of molecules. Viscosity of gases, effect of temperature/pressure on coefficient of viscosity (qualitative treatment only).

**8 Lectures, Marks - 8**

**Unit V: Liquids**

*Liquids*: Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

**6 Lectures, Marks - 6**

**Unit VI: Solids**

*Solids*: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. Bragg’s law. Structures of NaCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

**8 Lectures, Marks - 6**

**Unit VII: Chemical Kinetics**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

**8 Lectures, Marks - 8**

**Reference Books:**

**1.** G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).

**2.** G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).

**3.** B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).

**4.** J. D. Lee: A New Concise Inorganic Chemistry, ELBS.

**5.** F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.

**6.** D. F. Shriver and P. W. Atkins: Inorganic Chemistry, OUP.

**7.** Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.

CBCS: B. Sc. with Chemistry

**Generic Elective**

CHEMISTRY

**(4th Semester)**

Course Code: **CHE-GE-P2-401**

**(Contact Hours-60; Credits: 02)**

**Full Marks = 30 [**End Semester Exam (24) Internal Assessment (6)]

Time- 6hours

**1. *Section A: Inorganic Chemistry*: (*any one*) Marks - 2½×4=10**

**A.** Semi-micro qualitative analysis using H2S of mixtures- not more than four ionic species

(two anions and two cations and excluding insoluble salts) out of the following::

**Cations:** Pb2+, Ag2+, Bi3+, Cu2+, Cd2+, Sn2+, Fe3+, Al3+, Co2+, Cr3+, Ni2+, Mn2+, Zn2+, Ba2+, Sr2+, Ca2+, Mg2+, NH4+.

**Anions:** CO32- ,NO2-, NO3-, SO42-, Cl-, Br-, I-, BO33-, PO43-.

*Spot tests should be done whenever possible*.

**2. *Section B: Physical Chemistry*: (*any one*) *M*arks - 10**

**I. Surface tension measurement (*use of organic solvents excluded*).**

Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

**II. Viscosity measurement (*use of organic solvents excluded*).**

Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald’s viscometer.

**3. Viva-voce Marks - 4**

**Reference Books:**

**1.** A. I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Ed.

**2.** Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).