

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
		<b>Hard Core</b>							
<b>Third</b>	HCT3.1	Organic Chemistry-III (Spectroscopy)	80	20	100	4	0	0	4
	HCT3.2	Physical Chemistry-III	80	20	100	4	0	0	4
		<b>Soft-Core (Any One)</b>							
	SCT3.1	Analytical Chemistry-III	80	20	100	4	0	0	4
	SCT3.2	Inorganic Chemistry-III	80	20	100	4	0	0	4
		<b>Open Elective (Any One)</b>							
	OET3.1	Essential of Inorganic Chemistry	80	20	100	5	1	0	6
	OET3.2	Essential of Organic Chemistry	80	20	100	5	1	0	6
		<b>Practical</b>							
	HCP3.1	Organic Chemistry Practical -III	40	10	50	0	0	4	2
	HCP3.2	Physical Chemistry Practical-III	40	10	50	0	0	4	2
		<b>Soft-Core (Any One)</b>							
	SCP3.1	Analytical Chemistry Practical-III	40	10	50	0	0	4	2
	SCP3.2	Applied Inorganic Chemistry Practical-II	40	10	50	0	0	4	2
		<b>Total for Third Semester</b>	<b>440</b>	<b>110</b>	<b>550</b>				<b>24</b>

L = Lecture; T = Tutorials; P = Practical; 4 Credits of Theory = 3 hrs. teaching , 1hr. tutorials per week. 2 Credits of Practical = 4 hours Practicals per week; Scheme of Practical Evaluation: Expts-30 Marks, Viva-voce-5 Marks, Record-5 Marks = 40 Marks and IA 10 marks = 50 marks.  
**Major Project:** Evaluation-90 Marks , Viva-voce-30 Marks and IA 30 Marks = 150 Marks.

## Semester-III

### HCT 3.1: Organic Chemistry– III (Spectroscopy)

[64 Hours]

#### UNIT-I

##### **Electronic, Chiroptical and Vibrational Spectroscopy:**

Introduction, energy considerations, Beer-Lambert's law. Theory and classification of electronic transitions. Terminology, substituent and solvent effects. Woodward-Fieser rules and their application in structural elucidation of organic compounds.

UV spectral study of alkenes, dienes, polyenes. Carbonyl and aromatic compounds. Steric effects, isobetic points, model compounds and charge transfer bands.

Vibrational Spectroscopy: Introduction Complimentarity of IR and Raman. Fundamental vibrations, Overtones, group frequencies, factors affecting group frequencies; Conjugation, Inductive, Resonance, steric effects. Mechanical coupling, Fermi resonance. Applications of IR In the study of H-bonding, stereoisomerism, tautomerism. Identification of the following organic compounds by IR; Alkenes, Alkynes, Aromatic compounds, Aldehydes, Ketones, Alcohols, Thiols, Acids, Acid chlorides, Amides, Amines, Esters, Halides and Nitro compounds.

[16 Hours]

#### UNIT – II

##### **Proton Magnetic Resonance Spectroscopy:**

Introduction- chemical shift- Mechanism of shielding and deshielding in alkanes, alkenes , alkyl halides, aromatic compounds, carbonyl compounds and annulenes. Chemical shifts of different types of organic compounds- Empirical rules.

Spin-spin coupling, geminal and vicinal coupling. Relative intensities, Karplus equation-curve, equivalence of protons-chemical and magnetic equivalence. Spin system- First order and second order patterns.

Long range coupling- Spin decoupling, CIDNP, NOE, Lanthanide shift reagents.

Protons attached to elements other than carbon exchange phenomena and temperature effect.

[16 Hours]

#### UNIT – III

##### **Multi-Nuclear NMR and correlation spectroscopy:**

<sup>13</sup>C-NMR Broad band and off resonance decoupling, methods of detection.

<sup>13</sup>C chemical shifts of different classes of organic compounds- Alkanes, alkyl halides, alkenes, alcohols, ethers, carbonyl compounds and aromatic compounds.

<sup>13</sup>C-H coupling DEPT. Introductory aspects of <sup>15</sup>N, <sup>19</sup>F, <sup>31</sup>P-NMR. Correlation NMR spectroscopy.

Theory, pulse sequence. FT methods <sup>1</sup>H-<sup>1</sup>H (Cosy) and <sup>13</sup>C-H (Heterocopy) methods.

[16 Hours]

#### UNIT-IV

##### **Mass Spectrometry and Composite Problems:**

Ionization and mass analysis:

Instrumentation, methods of ionization, EI, CI, DI, SI-methods.

Fragmentation: Principle, odd and even electron ions, molecular ion and base peak, nitrogen rule, meta stable ions, Isotopic effect in chloro and bromo compounds. Stevenson rule.

Fragmentation of:

i) Normal and branched alkanes, ii) Alkenes iii) benzene and its derivatives iv) Alcohols v) Aldehydes vi) Ketones vii) Acids viii) Esters ix) Ethers x) Amines xi) Nitro compounds xii) Halo compounds xiii) Peptides.

Mc Lafferty and Mc Lafferty+1 rearrangement, calculation of molecular formula. Composite problems.

Applications of UV-VIS, IR, IR, NMR, and Mass spectral analysis in the structural elucidation of organic compounds.

[16 Hours]

### **Books Recommended:**

1. Introduction to spectroscopy- By D. L. Paxia, G. M. Lampman and G. S. Kriz.
2. Spectroscopic identification of Organic compounds by R. M. Silverstein and F. X. Webster, 6<sup>th</sup> edn, Wiley and Sons, India Ltd (2006).
3. Organic spectroscopy- by William Kemp, 3<sup>rd</sup> edn. Palgrave Publishers (2002).
4. Organic Structural spectroscopy- by J. B. Lambert, H. F. Shurvell, D. A. Lightner and R. G. Cooks. Prentice Hall Publishers, Jersey (1998).
5. Organic spectroscopy- by D. W. Brown, A. J. Floyd and M. Sainsbury, John Wiley and sons.
6. Applications of Absorption Spectroscopy of Organic compounds-by J. R. Dyer, Prentice Hall Publishers, New Delhi (1969).
7. Interpretation of mass spectroscopy- by Mc Lafferty.
8. Organic spectroscopy- V. R. Dani, Tata McGraw Hill Ltd (1995).
9. Spectroscopic of Organic compounds- by P. S. Kalsi, 4<sup>th</sup> edn, New Delhi (2005).
10. Organic spectroscopy- by Jag Mohar (Narosa Publishing House) (2001).
11. Organic spectroscopy- by Yadav.

### **HCP 3.1: Synthesis and Spectral Analysis**

[64 Hours]

Synthesis and Spectral Analysis of Synthesised compounds.

### **Books Recommended:**

1. Applications of computers in chemistry- Raman.
2. Computers and their applications to chemistry- Ramesh Kumar, Narosa Publishing House (2002).
3. Laboratory experiments in organic chemistry – Arun Sethi, New Age International ltd. New Delhi (2006).
4. A Hand book of Organic chemistry – H. T. Clarke.

5. Vogel's text book of practical organic chemistry, revised 5<sup>th</sup> edn, Addison Wesley, Longman Ltd, UK (1997).

## HCT 3.2: Physical Chemistry-III

[64 Hours]

### UNIT-I

**Statistical Thermodynamics and Quantum Statistics:** Microstates' and Microstates, Assemblies of localized and Non-localized systems, Phase space,  $\gamma$ -Space,  $\mu$ -Space, and Ensembles.

Classical Statistics: Maxwell-Boltzmann distribution law for ideal gases and mixture of gases equipartition of energies, Maxwell-Boltzmann distribution of velocities and energies (no derivation).

Quantum Statistics: Relationships between probabilities and entropy, Sterling approximation. Bose-Einstein, Fermi-Dirac and Maxwell-Boltzmann Statistics and comparison between them. Heat capacity of Ortho-Para hydrogen systems. Einstein's heat capacity for solids.

Partition Function: Definition and separation of partition functions. Translational, Vibrational, Rotational and Electronic partition functions for Monoatomic, Diatomic, and Polyatomic gaseous molecules. Sackur-Tetrode equation. Calculation of thermodynamic quantities in terms of partition functions, Residual entropy.

[16 Hours]

### UNIT-II

**Quantum Chemistry:** Review of concepts of operators. Applications of Schrödinger wave equation to Hydrogen like atoms, rigid Rotor, Harmonic oscillators and Hartree Self consistent field theory. Ab initio and Density functional analysis.

Approximation Methods-Variation theory and Perturbation theory (zero, first, second order).

MO Theory: MO Theory of Hydrogen molecule and ion, Bonding and Anti-bonding orbitals. Examples of MO of simple HOMO and HETERO nuclear molecules. Notations of few molecular orbitals, correlation diagrams and Non-crossing rules, Simple Huckel theory of linear conjugated systems (HMO) and applications to systems like benzene, ethylene and butadiene molecules.

VB Theory: Secular equation and determinants, Columbic, exchange and overlap integrals. VB theory of H<sub>2</sub> molecule. Comparison of VB and MO theories.

[16 Hours]

### UNIT-III

**Solid State Chemistry:** Solid state reactions: General principles and classification of reactions

Methods of Single Crystal Growth: Solution growth; Melt Growth-Bridgeman, Czochralski, Verneuil;

Chemical Vapour Transport; Fused Salt

**Characterization:**

**Thermal analysis:** TGA, DTA, DSC

**Electrical properties:** Band theory of solids; semiconductors - extrinsic and intrinsic, Hall effect; thermoelectric effects (Seebeck); Fermi energy levels and their determination for semiconductors. ferroelectric, pyroelectric and piezoelectric properties; ionic and superionic conductors. Superconductivity: Basics, discovery and high T<sub>c</sub> materials

**Magnetic properties:** dilute and concentrated magnetic systems. Dia, para, ferro, ferri, and antiferro magnetic types; soft and hard magnetic materials; select magnetic materials such as spinels, garnets and perovskites and hexaferrites magnetoresistance and giant magnetoresistance. Understanding.

**Optical properties optical, reflectance, photoconductance structure and properties** of amorphous materials (glasses) and zeolites

[16 Hours]

### UNIT-IV

**Thermodynamics, Non-equilibrium Thermodynamics and Colloids:** Solutions: Introduction, partial molar quantities, Gibb's function of mixing and other thermodynamic mixing functions(Gibbs-Duhmen and Duhmen-Margules equations), chemical potential of liquids and liquid mixtures, Excess function for non-ideal solutions. Non-equilibrium Thermodynamics: Microscopic reversibility, entropy production in irreversible process. Different types of forces and fluxes, stationary states

phenomenological equations. Onsagar's reciprocity relations, Principle of minimum entropy production, phenomenological in non-linear region.

Colloids: Electro kinetic phenomena of colloids, Classification of Surface active agents, Critical Micellar concentration (CMC), determination of Surface tension by 'Surface Tension Method'.

[16 Hours]

### Books Recommended:

1. Theoretical Chemistry- Glasstone.
2. Statistical Mechanics- Davidson.
3. Elements of Statistical Thermodynamics- E. K. Nash
4. Statistical Thermodynamics- M.C.Gupta
5. Introduction to Quantum Chemistry- A.K.Chandra
6. Quantum Chemistry- R.K.Prasad
7. Textbook of Quantum Mechanics-P M Mthews & P Venkateshan
8. Problems in Quantum Mechanics- G.L.Squiras.
9. Introduction to Solids- I. V. Azarrof.
10. Solid State Chemistry- A.R.west
11. Modern aspects of Solid State Chemistry- Ed. By C.N.Rao

12. New direction in Solid State Chemistry- C.N.Rao & Gopal Krishnan
13. Thermodynamics by L.M. Koltz & R.M. Rosenberg
14. Thermodynamics by Glasstone
15. Physical Chemistry by P.W. Atkins.
16. Molecular Quantum Chemistry by A. J. Atkins.
17. P. Ball, Designing the Molecular World: Chemistry at the Frontier, (1994) Princeton Univ. Press.

### **HCP 3.2: Physical Chemistry Practicals-III**

**[64 Hours]**

#### **Part-I**

1. Effect of added salt (Uni-Uni and Bi-Bi salts)
2. Determination of rate constant and order of reaction between  $K_2S_2O_8$  and KI.
3. Determination of equilibrium constant of reaction between  $KI + I_2 = KI_3$  by distribution method.
4. Kinetic study of iodination of an acetone.
5. Study of kinetics of inversion of cane sugar by Polarimetry.
6. Phase diagram of three component system.

#### **Part-II**

1. Titration of p-Toludine against HCl by conductometry.
2. Determination of end point of some typical titrations. (Precipitation & replacement) conductometrically.
3. Potentiometric titration of o-phosphoric acid against alkalies NaOH.
4. Potentiometric titration of halide mixture against  $AgNO_3$ .
5. Titration of mixture of HCl, AcOH,  $CuSO_4$  against conductometrically
6. Determination of equivalent conductance at infinite dilution of a strong electrolyte and verification of Onsgars law.
7. Potentiometric titration of  $Pb(NO_3)_2$  vs EDTA
8. Potentiometric titration of mixture of weak acids, HCOOH, CH<sub>3</sub>COOH, ClCH<sub>2</sub>COOH Vs NaOH Estimation of metal ions solution by plarographic method.
9. Determination of surface tension.

Note: the number of practical may be modified depending upon the facilities and requirements.

#### **Books Recommended:**

1. Fridley's Practical Physical Chemistry- B.P.levitt.
2. Advanced Practical Physical Chemistry- G.B.Yadav
3. Experiments Practical Physical Chemistry- Shomaker
4. Systematic experimental Physical Chemistry- S.W.Rajbhoj & T.K.Chondeker
5. Senior Physical Chemistry Practical- Kholsa et.al

## SCT 3.1: Analytical Chemistry-III

[64 Hours]

### UNIT - I

**Air pollution, analysis and control:** Historical overview-global implications of air pollution, sources of pollutants, classification pollutants. Sources and effects of particulates, carbon monoxide, sulphur oxides, nitrogen oxides, hydrocarbons and photochemical oxidants on human health, vegetation and materials. Standards for air pollutants.

**Air quality monitoring:** Sampling methods and devices for particulates and gaseous pollutants. SO<sub>2</sub>: ambient air measurements and stack gas measurements-Turbidimetric, colorimetric, conductometric and coulometric methods. NO<sub>x</sub>: Griess-ilosvay and Jacobs-Hockheiser colorimetric methods, chemiluminiscent technique. CO: NDIR, amperometric, FID and catalytic oxidation methods. Hydrocarbons: total and individual hydrocarbons by gas chromatography. Oxidants and ozone: colorimetric, coulometric, titrimetric, and chemiluminescence methods.

**Air Pollution control:** Atmospheric cleaning processes, approaches to contaminant control-detection and control at source.

**Control devices for particulates:** Gravitational settlers, centrifugal collectors, wet collectors, electrostatic precipitation and fabric filtration.

**Control devices for gaseous pollutants:** Adsorption, absorption, condensation and combustion processes. Automotive emission control-catalytic converters.

[16 Hours]

### UNIT – II

**Water pollution and analysis:** Water resources, origin of wastewater, types of water pollutants of their sources and effects, chemical analysis for water pollution control-objectives of analysis, parameters of analysis, sample collection and preservation. Environmental and public health significance and measurement of color, turbidity, total

solids, acidity, alkalinity, hardness, chloride, residual chlorine, chlorine demand, sulphate, fluoride, phosphates and different forms of nitrogen in natural and in waste/polluted waters, heavy metal pollution-public health significance of Pb, Cd, Cr, Hg, As, Cu, Zn and Mn, general survey of the instrumental techniques for the analysis of heavy metals in aquatic systems, organic loadings-significance and measurement of DO, BOD, COD, TOD, and TOC, phenols, pesticides, surfactants, tannin and lignin as water pollutants and their determination.

[16 Hours]

### UNIT-III

**Waste water treatment:** waste water characteristics, effluent standards, terminology in waste water treatment. Treatment of domestic waste water-preliminary treatment.

**Primary treatment:** sedimentation, equalization, neutralization.

**Secondary treatment:** Aerated lagoons, trickling filters, activated sludge process, oxidation ditch, oxidation pond and anaerobic digestion. Sludge treatment and disposal.

**Tertiary treatment:** evaporation, ion-exchange, adsorption, electro dialysis, electrolytic recovery and reverse osmosis.

**Advanced waste water treatment:** Nutrient removal-nitrogen and phosphorus removal, solid removal.

Waste water disposal and reuse. Industrial waste water and its treatment (paper and pulp, sugar and leather industries)

[16 Hours]

#### UNIT-IV

**Analysis of Complex Materials:** Composition, Properties and Analysis of:

**Minerals and Ores:** Hematite, pyrolusite, dolomite, chromate, bauxite and limestone,

**Metal and Alloys analysis:** Steel, Cu-Ni alloy, solder, bronze, brass and aluminum alloy.

**Analysis of structural materials:** Cement.

[16 Hours]

#### Books Recommended:

1. Standard Methods of chemical Analysis. A. J. Welcher (part B), Robert E. Krieger Publishing Co. USA, 1975.
2. Environmental Chemistry.S. E. Manahan, Willard grants press, London, 1983.
3. Environmental Chemical Analysis.Iain L Marr and Malcolm s. Cresses, Blackie and Son, Ltd, London, 1983.
4. Chemistry for environmental engineering.Chair N. Sawyer and Perry L. M Canty, McGraw Hill Book, Co., New York 1975.
5. The Air Pollution Hand Book.RichardMabey, Penguin, 1978.
6. The Pollution Hand Book.RichardMabey, Penguin 1978.
7. Soil Chemical Analysis.M. L. Jackson, Prentice Hall of India Pvt, Ltd., New Delhi, 1973.
8. Experiments in environmental chemistry.P. D. Vowler, and D.W. Counel, Pergamon press, Oxford 1980.
9. Manual Soil Laboratory Testing Vol-I. K. H. Head, Pentech Press, London 1980.
10. A Text Book of Environmental Chemistry and Pollution Control.S. S. Dara, S. Chand and Co. Ltd. New Delhi 2004.
11. Instrumental Methods for automatic air monitoring systems in Air Pollution Control Part-III edn, by W.Stranss, John-wiley and sons, New York, 1978.
12. Air pollution Vol-II.edn. A.C. Stern, Academic Press New York, 1968.
13. Analysis of Air Pollutants.P. O. Warner, John Wiley and sons, New York, 1976.
14. The Chemical Analysis Air pollutants, Interscience.New York, 1960
15. The Analysis of air pollutants.W. Liethe, Ann Arbor Science Pub. Inc. Michigan 1970.
16. Environmental Chemistry. A. K. De. New Age International (P) Limited, Publishers
17. Laboratory Manual for Environmental Chemistry.SunitaHooda and SumanjeetKaur, S. Chand & Company Ltd.
18. Environmental Pollution Analysis.S. M. Khopkar, New Age International (P) Limited, Publishers.

19. An Introduction to Air Pollution. P. K. Trivedi and P. K. Goel, Techno science Publications, Jaipur (Ind).
20. Practical Ecology. K. S. Rao, Anmol Publications Pvt. Ltd, New Delhi.
21. Encyclopedia of industrial methods of chemical analysis. F. D. Snell (All Senus)
22. Qualitative inorganic analysis by A. I. Vogel.
23. Chemical analysis of ferrous and nonferrous and foundry materials. Westwood and Mayar.
24. Chemical methods of analysis. Snell and Snell
25. A text book of inorganic analysis. A. I. Vogel.
26. Laboratory manual for Environmental chemistry. Sunita Hooda & Sumanjeet Kaur.
27. Analytical Chemistry. Dr. ALKA L. GUPTA apragati edition.
28. Applied Chemistry theory and practice second edition. O. P. Vermani. A. K. Narula

### **SCP 3.1: Analytical Chemistry Practical-III**

**[64 Hours]**

1. Determination of phosphorous by spectrophotometry.
2. Determination of COD of water.
3. Determination of hardness of water
4. Determination of chloride in a water sample
5. Determination of pH of soil.
6. Determination of Total dissolved salts and conductivity of water.
7. Analysis of solder.
8. Analysis of copper-nickel alloy.
9. Analysis of pyrolusite ore.
10. Analysis of steel

#### **Books Recommended:**

1. Standard Methods of chemical Analysis. J. Welcher (part B), Robert E. Krieger Publishing Co. USA, 1975
2. A text book of inorganic analysis. A. I. Vogel.
3. Chemical methods of analysis. Snell and Snell.
4. Practical Ecology. K. S. Rao, Anmol Publications Pvt. Ltd, New Delhi.
5. Laboratory manual for Environmental chemistry. Sunita Hooda & Sumanjeet Kaur.

### **SCT 3.2: Inorganic Chemistry-III**

#### **UNIT-I**

**Bio-inorganic Chemistry:** Essential and trace metals, chlorophyll and its role in photosynthesis; transport and storage of dioxygen-heme proteins; oxygen uptake-- functions of haemoglobin, myoglobin, hemerythrin and hemocyanins, synthetic oxygen carriers. Metal storage and transport, ferritin, transferrin and ceruloplasmin. Electron transfer proteins-cytochromes and iron-sulphur proteins; Biological nitrogen fixation; in vivo and in vitro nitrogen fixation, interactions of transition metal complexes.

**Metals in medicine:** Anti cancer agents, diabetes, arthritis, radionuclides and related applications.

[16 Hours]

#### UNIT-II

**Photoinorganic Chemistry:** Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times measurements for the times; Energy dissipation by radiative and non-radiative process.

**Excited States of Metal Complexes:** Excited states of metal complexes: comparison with organic compounds, electronically excited states of metal complexes. Charge-transfer spectra, charge transfer excitations, methods for obtaining charge-transfer spectra.

**Ligand Field Photochemistry :** Photosubstitution, photooxidation and photoreduction, lability and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states. Photo isomerisation and photo recimization reactions

**Metal Complex Sensitizers:** Metal complex sensitizer, electron relay, metal colloid system, semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation and carbon dioxide reduction.

[16 Hours]

#### UNIT-III

**Nuclear and Radio Chemistry:** Fundamentals; units of radioactivity; interaction of  $\alpha$ ,  $\beta$  and  $\gamma$  radiation with matter; Determination of half life period, radioactive decay, kinetics, parent-daughter decay-growth relationships; Detection and measurement of radioactivity; construction and operation of ionization chambers; G.M. counters and scintillators; Induced radioactivity, nuclear fission and fusion.

**Nuclear Reactors:** Characteristics features, nuclear reactors in actual use; some Indian reactors, applications of reactors--advantages and disadvantages of nuclear reactors, power reactors; Nuclear power stations in India, An introduction to breeder reactors. Applications of nuclear sciences. Nuclear waste management including waste storage and disposal procedures.

[16 Hours]

#### UNIT-IV

**Industrial Chemistry:** Introduction, Physical and chemical properties, raw materials, methods of manufacturing, types, uses with respective cement, ceramics, glass, iron, steel and alloys.

**Industrial pollution:** Industrial pollution with respect to cement, thermal power plants and metallurgy, disposable and its management.

**Chemical Toxicology:** Toxic chemicals in the environment; impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, CO, NO<sub>x</sub>, SO<sub>2</sub>, O<sub>3</sub>, PAN, cyanides, pesticides and carcinogens.

[16 Hours]

**Books Recommended:**

1. Fundamentals of Photochemistry - Rohatgi Mukherjee.
2. Photochemistry of co-ordination compounds - V. Balzarli and V. Carassitt (Academic Press).
3. Industrial Chemistry - B.K. Sharma (Goel Publishers).
4. Industrial Chemistry - Rogers (Wiley, Vol. I&II).
5. Environmental Chemistry - 4<sup>th</sup> Edition A.K. Dey (New Age International Publisher, (2001).
6. Test Book of Environmental Chemistry - O.D. Tyagi and M.Mehra (Anmol Publications).
7. Environmental Pollution Analysis - S.M. Khopkar (Wiley Eastern).
8. Principles of Instrumental Analysis - Skoog, Hollar and Nieman (Harcourt Asia Pvt Ltd., India New Delhi 5<sup>th</sup> Edition, 1998).
9. Instrumental Methods of Chemical Analysis – Chatwal and Anand (5<sup>th</sup> Edition).
10. Instrumental Methods of Chemical Analysis - H. Kaur.
11. Essentials of Nuclear Chemistry- H.J. Arnikar (Wiley Eastern, 1987).
12. Radiation Chemistry: An Overview – D.B.Naik and S. Dhanya (BARC, Mumbai).
13. Nuclear and Radiation Chemistry- B. K Sharma, 7th Edition 2011.
14. Fundamentals of radiochemistry-D.D.Sood, A.V.R.Reddy,N.Ramamoorthy.

**SCP 3.2: Applied Inorganic Chemistry Practicals – III**

(64 Hours)

1. Analysis of cement
2. Analysis of hematite ore: Estimation of silica by gravimetrically and iron by volumetrically.
3. Analysis of mint alloy: Estimation of copper by volumetrically and nickel by gravimetrically.
4. Separation and estimation of Al and Mg by using 8-hydroxyquinoline reagent
5. Separation and estimation of copper and nickel by using salicylaldehyde reagent
6. Separation and estimation of cations by using anion exchanger.
7. Separation and estimation of anions by using cation exchanger.
8. Determination of Ca in limestone by redox, acid-base and complexometric titrations.
9. Analysis of water sample for COD by titrimetry
10. Determination of DO in water sample.
11. Spectrophotometric determination of NO<sub>2</sub><sup>-</sup> -N in a water sample (Diazo coupling reaction).

12. Water analysis: TDS, conductivity, acidity, alkalinity, hardness, sulphate, chloride and fluorides.

### Books Recommended:

1. Vogel's Text Book of Quantitative Inorganic Analysis- J. Basset, R. C. Denney, H. Jeffery and J. Mendham, Longmans, Green and company Ltd.
2. Practical Inorganic Chemistry-G. Pass and H. Sutcliff, Chapman and Hall Ltd. (1968).
3. General Chemistry Experiments-A. J. Elias, University Press.
4. Analytical chemistry, Alka L. Gupta, A Pragati Edition., Third edition, 2010.

## OET 3.1: Essentials of Inorganic Chemistry [64 Hours]

### UNIT – I

**Ionic bonding:** Properties of ionic compounds, lattice energy, Born-Land's equation, Born-Haber cycle and its applications, Kapustinskii equation, Solvation energy, dissolution of ionic compounds in polar solvents and their energetics. The predictive power of thermochemical calculations of ionic compounds, covalent character in ionic compounds. Radius ratio and structure of ionic compounds and efficiency of packing of crystal lattices.

**Covalent bonding:** Valence bond theory, orbital overlap, molecular orbital theory, symmetry and overlap, molecular orbital diagrams of diatomic molecules (homo- and hetero- nuclear), triatomic molecules, linear ( $\text{CO}_2$ ,  $\text{N}_2\text{O}$ ) and angular ( $\text{NO}_2$ ), Walsh diagrams, Bent rules, some reactions of covalently bonded molecules, Resonance, hybridization, VSEPR theory, molecular geometries.

[16 Hours]

### UNIT – II

**An over view of metals in biology:** Introduction; the element content of living systems; biological chemistry of hydrogen; the economical use of resources—abundance and availability; biological need and behavior of inorganic elements.

**Sodium and potassium channels and pumps:** Introduction; transport across membranes; potassium and sodium channels; the sodium and potassium pump; active transport driven by  $\text{Na}^+$  gradients, sodium/proton exchangers; other roles of intracellular  $\text{K}^+$ .

**Metal assimilation pathways:** Introduction; metal assimilation in bacteria, plants, fungi and in mammals (iron, copper and zinc).

**Storage and homeostasis of metal ions:** Introduction; metal storage and homeostasis in bacteria, plants, fungi and in mammals (iron, copper and zinc).

[16 Hours]

### UNIT – III

**Stereochemistry of Coordination Compounds:** Coordination geometry, types of isomerism (geometrical & optical). Review of bonding theories; Molecular orbital theory/Ligand field theory (octahedral, tetrahedral and square planar complexes), MO

theory applied to complexes with  $\pi$ -bonding. Evidences for metal-ligand orbital overlap, spectrochemical series and Jahn-Teller distortion in coordination compounds.

**Magnetism:** Types of magnetism; magnetic susceptibility; spin only moment; orbital contribution to spin only moment.

[16 Hours]

#### UNIT – IV

**Review of Acid-Base Concepts:** Introduction, different definitions, types of reactions, solvent system and leveling effect. Generalized Acid-Base concepts (basicity of metal oxide, hydratin and hydrolysis).

Measurement of Acid-Base strengths, Steric effect (back strain, front strain and Internal strain) Solvation effects with reference to liquid ammonia, anhydrous sulfuric acid, acetic acid and liquid sulfur dioxide. Hard-Soft Acids and Bases; classification, strength of hardness and softness; Irving William series; theoretical basis of hardness and softness.

[16 Hours]

#### Books Recommended:

1. Advanced Inorganic chemistry - F.A.Cotton and Wilkinson, John-Wily and sons
2. Chemistry of the Elements - N.N.Greenwood and A. Eamshaw, Pergamon
3. Concise Inorganic Chemistry - J.D. LEE, ELBS
4. Inorganic Chemistry, Principles and Reactivity -J.E.Huheey, Harper and Row
5. Modern aspects of Inorganic Chemistry - H.J. Emuleus and A.G.Sharpe ELBS
6. Theoretical Inorganic Chemistry - M.C.Day, Jr. an J.Selbin East-West press
7. Concept and Model's in Inorganic Chemistry - Dougals, McDanial and Alexander John Wiley and sons.
8. Inorganic Qualitative Analysis - A.I.Vogel ELBS
9. Fundamentals of Analytical Chemistry - D.A.Skoog, D.M.West and F.T.Holler, Saunder college publishing
10. Inorganic Quantitative methods - Alexeev Mir publications
11. Principles of Inorganic Chemistry - Puri, Sharms and Kalia-Shobanlal-Nagin.
12. An Introduction to Inorganic Chemistry - Purcell and Kotz-Holt-Saunders
13. Coordination Chemistry-S.F.A. Kettle.
14. Comprehensive coordination Chemistry - G. Wilkinson, R.D. Gillars and J.A.Mccleverty, Pergamon

## OET 3.2: Essential of Organic Chemistry

[64 Hours]

### UNIT-I

#### Bonding and Aromaticity:

Hybridization, bond length, bond angle, bond energies, bond polarity and dipole moment aromaticity and Huckels rule-HMO theory, Non-benzenoid aromatics, Annulenes (10-18).

[16 Hours]

### UNIT-II

#### Stereochemistry:

Elements of symmetry, symmetry operations E/Z, R/S nomenclature, Fischer, newman Sawhorse and flywedge projection, Enantiomers, Diastereomers and Epimers. Prochirality: Homotopic, enantiotopic, diastereotopic groups and faces

[16 Hours]

### UNIT-III

#### Organic Reactions:

Reactivity, classification of organic reactions, methods of identification kinetics, non kinetic methods. Isotopic labeling techniques, intermediates, cross over products and product proportions in different types of reactions. Named reactions. Classification, Aldol, Dieckmann, Claisen-Schmidt and similar anion addition reactions.

[16 Hours]

### UNIT-IV

#### Heterocycles and Group Transformations:

Structure, synthesis, reactivity of the following heterocycles and their biologically important derivatives. pyrrole, furan, thiophene, pyridine, pyrimidine, Quinoline, isoquinoline & indole. Organic functional group inter conversions involving substitution, addition, eliminations, oxidation, reductions, esterification and hydrolytic reactions.

[16 Hours]

#### Books Recommended:

1. Organic Chemistry-P. Y. Bruice, Pearson education pvt. Ltd, New Delhi (2002).
2. Organic Chemistry- S. H. Pine, McGraw Hill, London (1987).
3. Organic Chemistry- R. T. Morrison, R. J. Boyd, Prentice Hall, New Delhi (1994).
4. Organic Chemistry-T. W. Graham Solman 4<sup>th</sup> edn, John Wiley & Sons (1988).
5. Organic Chemistry- Vol. I & II, I. L. Finar, 6<sup>th</sup> Edn. ELBS, London (2004).
6. Organic Chemistry- F. A. Karey, 4<sup>th</sup> edn, McGraw Hill (2000).
7. Advanced Organic Chemistry Reaction Mechanism and Structure- J. March, 4<sup>th</sup> edn. Wiley Eastern Ltd. (2004).
8. Stereochemistry- Conformation and Mechanism, P. S. Kalsi, Wiley-Eastern Ltd., New Delhi (1992).
9. Heterocyclic Chemistry- T. L. Gilchrist, Butterworth, London (1985).
10. Heterocyclic Chemistry- J. A. Joule & G. F. Smith, 2<sup>nd</sup> edn, Van Nostrand, London (1978).