Course No: CH15201CR
Title: Inorganic Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *48 Contact hours (48L)*
End Term Exam: *60 Marks* ***Continuous Assessment****: 15 Marks*

Unit-I Mechanisms of Ligand Substitution Reactions in Metal Complexes (16 Contact hours)

Octahedral Complexes**:** Types of substitution reactions mechanistic classification of substitution reactions (Dissociative, Associative, Dissociative conjugate base and Interchange). Empirical criteria to differentiate the mechanism of substitution.

Substitution in octahedral complexes: Classification of metal ions based on water exchange rates. Metal-complex formation- the Eigen-Wilkins mechanism and anation reactions.

Hydrolysis Reactions: Simple Acid hydrolysis, Acid catalysed and Base hydrolysis. Stereochemical changes in octahedral substitution reactions. Substitution reactions without metal-ligand bond breaking.

Square-Planar Complexes**:** Significance of the two-term rate-law, mechanism, and steric course of the substitution reactions.

Factors affecting the rate of substitution: Entering and leaving groups, nucleophilicity of entering group, n_{pt} scale, central metal ion, solvent and the non-leaving groups.

The Trans effect: Theories, applications in synthesis.

Unit-II Electron Transfer Reactions in Coordination Complexes (16 Contact hours)

Complementary and Non-complementary reactions. Classification as outer sphere and inner sphere redox reactions.

Mechanism of outer sphere and inner sphere electron transfer reactions: the elementary steps involved, formation of precursor and successor complexes, rate laws. Characterization of redox reactions as outer and inner sphere.

Factors Affecting the Rate of Electron Transfer: Chemical activation, sigma and pi nature of donor/ acceptor orbitals, electron configuration of oxidant/reductant. Bridging ligand effects in inner-sphere reactions.

Oxidative addition, reductive elimination and migration (insertion) reactions.

Unit-III Organometallic Compounds (16 Contact hours)

Introduction, importance of organometallic compounds as reagents, additives and catalysts.

Nomenclature and classification of organometallic compounds.

Effective atomic number (18-valence electron) rule and its significance.

Stability of Organometallic Compounds towards heat, oxidation and hydrolysis.

Preparation, properties, structure, bonding and applications of alkyl and aryl compounds of Li, B and Al. Synthesis, structure and bonding in Zeise's Salt.

Homogenous catalysis using organometallic compounds: Catalysis, terminology of catalysis and Tolman catalytic loop. Hydrogenation and Hydroformylation reactions in alkenes.

Books Recommended

1. Reaction Mechanism of Inorganic and Organometallic Systems; 3rd edn. ; R. B. Jordan; Oxford; 2007.
2. Advanced Inorganic Chemistry; 5^{th} and 6^{th} edn. ; F.A. Cotton, G. Wilkinson; Wiley; 1988/1999.
3. Inorganic Chemistry; 4th edn. ; J. E. Huheey, E. A. Keiter; Harper Collins; 2009.
4. Chemistry of the Elements; 2nd edn. ; N. N. Greenwood, A. Earnshaw; Butterworth; 1997.
5. Mechanisms of Inorganic Reactions; D. Katakis, G. Gordon; Wiley; 1987.
6. Mechanisms of Inorganic Reactions; 2nd edn. ; F. Basolo, R.G. Pearson; Wiley; 1967.
7. Inorganic Chemistry; K. F. Purcell, L. C. Kotz; Saunders; 1977.
8. Electronic Spectra of Transition Metal Complexes; D. Sutton; McGraw Hill; 1968.
9. Elements of Magnetochemistry; R. L. Dutta, A. Syamal; Affiliated East- West; 1993.
10. Inorganic and Organometallic Reaction Mechanisms; 2^{nd} edn.; Jim D. Atwood; Wiley; 1997

Course No: CH15202CR
Title: Organic Chemistry (03 Credits)

Max. Marks: *75* ***Duration: 48*** *Contact hours (48)*
External Exam: *60 Marks* ***Internal Assessment****: 15 Marks*

Unit-1 Mechanistic Study of Organic Reactions - I (16 Contact hours)

Aromatic Electrophilic Substitution**:** Overview, Arenium ion mechanism, Sigma and pi – complexes, energy profile diagram, Effect of leaving group. Orientation and reactivity in monosubstituted benzene rings , *Ortho / Para ratio*, Ipso attack.

The Third substitution**:** Orientation of substitution in benzene ring with more than one substituents. Orientation in other ring systems. Carboxylation of aromatic rings with $COCl_2$ and amidation with NH_2COCl. Reversal of F. C. acylations. Synthetic application of F. C. Acylation and Nitration reactions (Toluene to nitro benzoic acids, synthesis of *ortho & Para* nitroanilines)

Aromatic Nucleophilic substitution**:** Discussion of different mechanisms (S_N1, S_NAr, Benzyne and $S_{RN}1$). Structure reactivity relationships. Effect of leaving group and attacking nucleophile. Mechanisms of Von- Richter, Sommelet-Hauser and Smiles rearrangements and Chichibabin reaction.

Free Radical Substitution**:** Free radical substitution mechanisms. Mechanisms at an aromatic substrate. Neighbouring group assistance in free radical reactions. Reactivity for aliphatic and aromatic substrates. Reactivity in the attacking radical. Effect of solvent on reactivity.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, free radical rearrangements and Hunsdiecker reaction.

Unit-II Mechanistic Study of Organic Reactions – II (16 Contact hours)

Addition to carbon-carbon multiple bonds: General mechanism, reactivity, orientation and stereochemical implications of addition reactions involving electrophiles, nucleophiles and free radicals. Addition to cyclopropane ring. Hydrogenation of double/triple bonds and aromatic rings. Hydroboration, Ene-reaction, Michael reaction and Sharpless assymetric epoxidation.

Addition to carbon-hetero multiple bonds. Overview of reactive carbonyl compounds, mechanisms of addition of water, hydrogen cyanide, alcohols, amines. Addition of hydrazine, organometallic reagents and hydrides to aldehydes and ketones. Mechanism of Wittig, Mannich, Aldol, Cross Aldol, Cannizarro's, Knoevenagel, Robinson annulation, Claisen, Dickman , Benzoin , Perkin and Stobbe's reactions. Mechanism of conjugate nucleophilic addition to α, β- unsaturated carbonyl compounds.

Unit-III Mechanistic Study of Molecular Rearrangements (16 Contact hours)

Molecular Rearrangements**:** General mechanistic treatment of nucleophilic, electrophilic and free radical rearrangements. Nature of migration and migratory aptitude and memory effect. Detailed mechanistic study and application of following rearrangements: Wagner-Meerwein, Pinacol-Pinacolone, Demyanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert, Neber, Hofmann, Curtius, Lossen, Schmidt, Beckmann, Strveons, Dakin Baeyer-Villiger, Pyne and Dienone-Phenol rearrangements.

Books Recommended

1. Advanced Organic Chemistry Reactions, Mechanism and Structure; 6th edn. ; Jerry March; Wiley; 2012.
2. Advanced Organic Chemistry; 5th edn. ; F. A. Carey and R. J. Sundberg; Springer Plenum; 2007.
3. A Guide Book to Mechanism in Organic Chemistry; 6th edn. ; Peter Sykes; Longman; 1996.
4. Structure and Mechanism in Organic Chemistry; 2nd edn. ; C. K. Ingold; CBS; 1994.
5. Modern Organic Reactions; 2nd edn. ; H.O. House; Benjamin; 1972.
6. Principles of Organic Synthesis; 2nd edn. ; R.O.C. Norman; Chapmann Hall; 1978.
7. Reaction Mechanism in Organic Chemistry; 3rd edn. S.M. Mukherjee and S.P. Singh; Macmillan; 1998.
8. Organic Chemistry; J. Hornback; Brooks/Cole; 1998.
9. Fundamentals of Organic Chemjstry; 10th edn. ; Solomons; Wiley; 2012.
10. Organic Chemistry, 5th edn. ; John McMurry; Brooks/Cole; 2000.

Course No: CH15203CR
Title: Physical Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *48 Contact hours(48L)*
End Term Exam: *60 Marks.* ***Continuous Assessment****: 15 Marks*

Unit-I Quantum Chemistry (16 Contact hours)

General theory of angular momentum. Eigen functions and Eigen values of angular momentum operators. Ladder operators. Spin angular momentum, antisymmetry and Pauli's principle. Wave functions of poly-electron atoms, Slater determinant. Atomic term symbols, term separation of p^n and d^n configurations, spin-orbit coupling, Zeeman splitting.

Approximation methods: The Variation theorem, linear variation principle, application to hydrogen atom and helium atom. Perturbation theory: first order (non-degenerate & degenerate). Application of perturbation method to helium atom and anharmonic oscillator.

Chemical Bonding: LCAO-MO approximation, H_2^+ molecular ion, brief introduction to H_2. Molecular term symbols. Valence bond treatment of H_2, comparison of MO and VB methods in the light of H_2 molecule.

Unit-II Statistical Thermodynamics (16 Contact hours)

Concept of distribution, thermodynamic probability and most probable distribution. Sterling approximation.

Distribution Laws: Derivation of Boltzmann distribution law, Bose-Einstein and Fermi-Dirac laws (without derivation) and their comparison with Boltzmann distribution law.

Partition function: Significance, translational, rotational, vibrational and electronic partition functions. Calculation of thermodynamic properties in terms of partition functions, application to ideal monoatomic & diatomic gases. Equilibrium constant in terms of partition functions with application to isomerization and atomization reactions.

Unit-III Chemical Kinetics (16 Contact hours)

Surface Reactions**:** Unimolecular and bimolecular surface reactions (Langmuir-Hinshelwood and Langmuir-Riedel mechanisms), classical and statistical treatment.

Ionic reactions: Reaction between ions in solution(single and double sphere models). Diffusion controlled reactions (partial and full microscopic diffusion control)

Enzyme catalyzed reactions: Kinetics of enzyme catalyzed reactions – effect of substrate concentration, temperature and pH.

Polymerization reactions: Kinetics and mechanism of free radical, cationic and anionic polymerization reactions.

Oscillatory Reactions**:** An introduction with reference to BZ-reaction.

Books Recommended:

1. Physical Chemistry; P. W. Atkins; ELBS; Oxford; 1997.
2. Physical Chemistry- A Molecular Approach; D. A. McQuarie & J. D. Simon; University Science Books; 1997.
3. Introduction to Quantum chemistry; A. K. Chandra; Tata McGraw Hill; 1997.
4. Quantum Chemistry; Ira. N. Levine; Prentice Hall; 2000.
5. Quantum Chemistry; Prasad; New Age Publishers; 2000.
6. An Introduction to Statistical Thermodynamics; Robert P. H. Gasser and W. Graham Richards; World Scientific Publishing Co. ; 1995
7. Statistical Thermodynamics; M. C. Gupta; New Age International; 1993.
8. Statistical Mechanics; Agarwal, Eisner; Wiley; 1991.
9. Introduction to Statistical Thermodynamics; Chandler; OUP; 1987.
10. An introduction to Statistical Thermodynamics; Hill; Addison-Wesley; 1987.

Course No: CH15204CR

Title: Laboratory Course in Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *96 Lab hours (96P)*

End Term Exam: *60 Marks* ***Continuous Assessment****: 15 Marks*

Unit-I Laboratory Course in Inorganic Chemistry (32 Lab hours)

A Qualitative Analysis by Semi micro Technique: Discussion about the analysis scheme. Analytical groups and Group reagents. Scales of Analysis, Skill of semi micro technique. Chemistry involved in separation and identification of less familiar cations by semi micro analysis.

B Identification of four less familiar cations from different analytical groups with simple and complex combinations:

(i) Group I and II A
(ii) Group I, II A and II B
(iii) Group IIA and II B
(iv) Group I and Group III
(v) Group II B and Group III
(vi) Group III only.

Unit-II Laboratory Course in Organic Chemistry (32 Lab hours)

A ***Separation, Purification and Identification of Organic compounds from a two component mixture***

(a) Separation based on solubility in water
(b) Separation based on solubility in organic solvents.
(c) Separation based on chemical properties: Solubility in Sodium bicarbonate, Sodium Hydroxide and Hydrochloric acid.
(d) Identification of individual components using physico-chemical properties

B ***Organic Preparations***

(a) Acetylation of Cholesterol or salicylic acid.
(b) Preparation of adipic acid from oxidation of Cyclohexanol by chromic acid
(c) Dibenzal acetone and benzaldehyde
(d) Aldol condensation
(e) Preparation of benzyl acetophenone from acetophenone
(f) Cannizarro's reaction of 4-Chlorobenzaldelyde.
(g) Aromatic electrophillic substitutions in benzene, benzoic acid or aniline.
(h) Haloform reaction: Preparation of Iodoform
(i) Beckmann rearrangement starting from acetophenone
(j) Preparation of p-bromo acetanilide starting from aniline.

Unit-III Laboratory course in Physical Chemistry (32 Lab hours)

A. Potentiometry

1. Determination of strength of an acid by titration with an alkali using quinhydrone electrode.
2. Determination of pKa value of a weak acid through potentiometry.

B. *Spectrophotometry*

1. Establishing the validity of Beer-Lambert law.
2. Determination of composition of a binary mixture through spectrophotometry.

C. Conductometry

1. Determination of the composition of a mixture of HCl and CH_3COOH by titration with standard NaOH.
2. Determination of degree of dissociation of a weak acid.

Books Recommended

1. Vogel's Qualitative Inorganic Analysis; 7^{th} edn. ; Svehla; Longman; 1996..
2. Experiments and Techniques in Organic Chemistry; D. Pasto, C. Johnson and M. Miller; Prentice-hall; 1992.
3. Microscale and Macroscale Organic Experiments; K.L. Williamson; D.C. Heath and Co. ; 1989.
4. Advanced Practical Organic Chemistry; 2nd edn. ; N. K. Vishnoi; Vikas; 1999.
5. Vogel's Textbook of Practical Organic Chemistry; 5th edn. ; A. R. Tatchell; ELBS; 1996.
6. Comprehensive Practical Organic Chemistry; V. K. Ahluwalia and Renu Aggarwal; University Press; 2000.
7. Practical Physical Chemistry; Findley, Kitchener; Longman;1977
8. Advanced Practical Physical Chemistry; Yadav; Goel Pub.; 1994.
9. Experiments in Physical Chemistry; 5th edn. ; Schoemaker et al.; MGH; 1989.
10. Experimental Physical Chemistry; Arthur M. Halpern George C. McBane, Freeman; 2006.
11. Chemistry Experiments for Instrumental Methods; Sawyer, Heineman, Beebe; Wiley; 1984

Course No: CH15204DC
Title: Chromatography and Analytical Techniques (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*
End Term Exam: *40 Marks* ***Continuous Assessment****: 10 Marks*

Unit-I Electrophoresis and Polarographic Methods (8 Contact hours)

Electrophoresis: Factors affecting ion migration, electro-osmosis, theory and applications of capillary electrophoresis.

Polarography: diffusion current, half-wave potential, Ilkovic equation, DME. (Applications in organic/inorganic analysis).

Amperometric titrations: Basic principle and applications.

Unit- II Coulometric and Thermal Methods (8 Contact hours)

Coulometry: Controlled-Potential coulometry, Constant-Current coulometric titrations. Electrogravimetry

Thermal Methods: Thermogravimetry (TG/TGA), Differential Thermal analysis (DTA), Differential Scanning calorimetry (DSC): Principle, instrumentation and applications. Thermometric titrations

Unit III Chromatographic Techniques I (08 Contact hours)

Introduction, Types and Classification, principles, differential migration, nature of partition forces, partition, Mobile phases, stationary phases, resolution, plate theory (concept), separation time, zone migration, column packing materials, development techniques, differential migration, partition coefficient, retention time and retention volume.

Liquid-Solid and Liquid-Liquid column chromatography: Basic principles and applications.

Thin layer chromatography: Theory, principle, adsorbents, preparation of plates, solvents, preparative TLC.

Unit IV Chromatographic Techniques II (08 Contact hours)

Gas-Liquid chromatography: Principle, columns and stationary phase, resolution and instrumentation.

HPLC: Theory, column efficiency, extra column and band broadening, temperature effects and diffusion. Chiral chromatography, chiral stationary phases. Applications of HPLC.

Ion exchange and size exclusion chromatography: Principle, mechanism of separation and applications.

Books recommended

1. Principles and Practice of Analytical Chemistry; 5th Edition; F. W. Fifield, D. Kealey; Blackwell Sciences Ltd.; 2000.
2. Modern Analytical Chemistry; David Harvey; McGraw-Hill; 2000.
3. Chromatographic Methods; 5^{th} edn. ; A. Braithwaite and F. J. Smith; Kluwer Academic Publishers.
4. Fundamentals of Analytical Chemistry; 6^{th} Indian Reprint; D. A. Skoog and D.M. West; Cenage Learning; 2012.
5. Thin layer Chromatography; E. Stahl and George Allen; Unwin Ltd. London.

Course No: CH15205DC
Title: NMR and ESR Spectroscopy (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*
End Term Exam: *40 Marks* ***Continuous Assessment****: 10 Marks*

Unit-I NMR Spectroscopy-I (08 Contact hours)

Basic principles, Nuclear spin, spin angular momentum, quantization of angular momentum. Nuclear magnetic moment, precessional (Larmor) frequency, energy levels in a magnetic field, resonance absorption of radio frequency radiation. Population of energy levels, Relaxation processes (T1, T2). Shielding and deshielding of magnetic nuclei. Chemical shift, its measurement and factors influencing chemical shifts; local paramagnetic and diamagnetic shielding, neighboring group anisotropy and ring currents in aromatic systems

Unit-II NMR Spectroscopy-II (08 Contact hours)

Spin- Spin coupling, coupling constants. Examples.
Vicinal coupling and electron correlation. Chemical equivalence and magnetic equivalence.
Fermi contact and Dirac Vector Model. Effect of Chemical exchange on spectra.
Double resonance techniques; spin decoupling, nuclear overhauser enhancement.
Instrumentation; FT-NMR and its advantages. NMR studies of nuclei other than proton – ^{13}C, ^{19}F and ^{31}P.

Unit-III ESR spectroscopy-I (08 Contact hours)

Basic principles- electron spin, magnetic moment of an electron and its interaction with applied magnetic field. Splitting of spin energy states and absorption of microwave radiation.
Hyperfine coupling, Isotropic and anisotropic hyperfine coupling constants, Examples

Unit-IV ESR spectroscopy-II (08 Contact hours)

Fermi contact, Spin polarization effects, Dipolar coupling, Mc Conell equation and calculation of spin densities in inorganic radicals such as $CO_2^{-\bullet}$, $CH_3^{\bullet}$, $BH_3^{-\bullet}$ and $F_2^{-\bullet}$.
Spin orbit coupling and significance of g tensors.
Zero field splitting and Kramer's degeneracy (fine structure),
Advance Applications

Books Recommended

1. Introduction to Spectroscopy; 3rd edn.; D. L. Pavia, G. M. Lampman, G. S. Kriz; Saunders-Thomson learning; 2001.
2. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry; R. V. Parish; Ellis Horwood; 1990.
3. Nuclear Magnetic Resonance; P. J. Hore; Oxford; 1995.
4. Principles of Instrumental Analysis; 4th edn.; D. A. Skoog, J. J. Leary; Saunders; 1992.
5. Physical Methods for Chemists; 2nd edn.; R. S. Drago; Saunders; 1992.
6. Basic Principles of Spectroscopy; R. Chang; McGraw Hill; 1971.
7. Introduction to Magnetic Resonance; A Carrington, A. D. McLachlan; Harper & Row; 1967.
8. NMR and Chemistry; 2nd edn.; J. W. Akitt; Chapman and Hall; 1983.

Course No: CH15206DC
Title: Solid State Chemistry (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*
End Term Exam: *40 Marks* ***Continuous Assessment****: 10 Marks*

Unit-I Structure of Solids (8 Contact hours)

Miller indices; Bragg equation, Debye-Scherrer method of X-ray structural analysis of crystals, identification of cubic unit cells from systematic absences in diffraction pattern. *S*tructure factor and its relation to intensity and electron density.

Crystal defects and their types, Point defects: Schottky and Frenkel defects, Thermodynamics of Schottky and Frenkel defect formation, Colour centres, Dislocations and their types.

Unit-II Theories of Solids (8 Contact hours)

***Free electron theory of metals*:** The Drude Model, Lorentz modification, Sommerfield Model; Fermi-Dirac distribution function, Density of states, electron heat capacity, Hall effect.

***Electron Energy Bands*:** Energy bands in general periodic potential-Kronig-Penney model. Qualitative band schemes for insulators, semiconductors and metals.

Unit-III Semiconducting and superconducting Properties of Solids (8 Contact hours)

***Semiconductors*:** Intrinsic & extrinsic semiconductor (n-type & p-type), temperature dependence of charge carriers, p-n junction- devices based on p-n junction (tunnel diode, injection laser).

Super conductors: Characteristic properties- Zero resistance, Meissner effect, Heat capacity, Thermal conductivity, absorption of em radiations and Josephson effect. BCS theory of superconductivity. Applications.

Unit-IV Dielectric and Magnetic Properties of Solids (8 Contact hours)

***Dielectric Properties of Solids*:** Dielectric constant, Polarization and Polarizability, Piezoelectricity, pyroelectricity and ferroelectricicity, ferroelectric materials and their applications.

***Magnetic properties of solids*:** origin of magnetism in solids, Diamagnetism, paramagnetism (Langevin's and quantum mechanical formulations), ferromagnetism (Wiess theory), antiferromagnetism and ferrimagnetism. Temperature dependence of magnetization.

Books Recommended

1. Physical Chemistry; P. W. Atkins; ELBS ; Oxford; 1997.
2. Physical Chemistry- A Molecular Approach - D. A. McQuarie& J. D. Simon, University Science Books, 1997.
3. Introduction to Solids, Azaroff, Tata McGraw,1993.
4. Solid State Chemistry and its Applications, West, Wiley,1989.
5. The Physical Chemistry of Solids, Borg, Biens, Academic press, 1992.
6. Solid State Reactions, Schmalzried, Academic press, 1995.
7. Solid State Physics, N.W.Ashcroft and N.D.Mermin, Saunders college, 2001.
8. Elements of Solid state Physics, J.P. Srivastava, Prentice Hall of India, 2003.

Course No: CH15207GE
Title: Metal Ions in Living Systems (02 Credits)

Max. Marks: **50** ***Duration:*** **32** *Contact hours*
End Term Exam: 40 *Marks* ***Internal Assessment****: 10 Marks*

Unit I Introduction to Bioinorganics (08 Contact hours)

Biomolecules and their Metal Coordination behavior.

Evidence of the presence of metal ions in biological systems (Direct / Indirect). Classification of metals and non-metals according to their action in biological systems.

Essential Elements: Concept of essentiality, criteria and classification of essential elements as per their role in living systems.

Unit II Alkali and Alkaline Earth Metal ions in Biosystems (08 Contact hours)

Alkali Metals: Role of Sodium and Potassium, mechanism of transport across the cell membrane. Role of Lithium in mental health.

Alkaline Earth Metals: Intra and Extra-cellular calcium building proteins. Role of Magnesium in chlorophyll.

Unit III Biological Activity of Essential Trace Elements (08 Contact hours)

Iron: Storage and transport through Ferritin and Transferrin.

Hemoglobin and Myoglobin: Structure, iron binding sites and role of iron in oxygen transport.

Copper in Biochemical systems: Electron transfer, oxidation and oxygenation of substrates. Dioxygen transport (Haemocyanin).

Zinc in Biosystems: Lewis acid catalyst, Enzyme activator in vitamin B_{12}.

Unit IV Metallotherapy (08 Contact hours)

Biochemical basis of essential metal deficient diseases and their therapies (Iron, Zinc, Copper and Manganese).

Metal complex as anticancer drugs: Platinum, Rhodium and Gold complexes.

Antibacterial, Antiviral and Antifungal activities of metal complexes: Labile and Robust metal complexes; probable mechanism of action.

Books Recommended

1. Bioinorganic Chemistry-A Survey; Ei- Ichiro Ochiai; Academic Press; 2008.
2. Bio inorganic Chemistry- An introduction; Ochiai; Allyn and Bacon; 1977.
3. Inorganic Biochemistry; Vol. 1&2; Eichhorn; Elsevier, 1973.
4. Inorganic Aspects of Biological and Organic Chemistry; Hanzilik; Academic Pub.; 1976.
5. The Inorganic Chemistry of Biological processes; 2nd edn. ; Hughes ; Wiley; 1973.
6. A Text book of Medicinal aspects of Bio inorganic Chemistry; Das; CBS; 1990.
7. The Biological Chemistry of Elements; Frausto de Silva; Williams; Clarenden; 1991.
8. Principles of Bio inorganic Chemistry; Lippard, Berg; Univ. Science Books; 1994.

Course No: CH15208GE
Title: Soil Chemistry and Environmental Analysis (02 Credits)

Max. Marks: **50** ***Duration:*** **32** *Contact hours*
End Term Exam: 40 *Marks* ***Internal Assessment****: 10 Marks*

Unit I Nature and Composition of Soil (08 Contact hours)

Water and Air in soil. Inorganic and Organic components in soil. Soil Humus and soil solution. Acid-Base and Ion-Exchange reactions in soils. Production of mineral acids, Soil acidity and Ion-exchange equilibria in soil. Macro- and Micro-nutrients in soil.

Unit II Soil Pollution (08 Contact hours)

Fertilizers, pesticides, fumigants and livestock production.

Wastes and pollutants in soil: Chemical degradation, photochemical reactions and Biodegradation.

Soil loss and Degradation: Desertification, Deforestation and Soil erosion.

Unit III Environmental Analysis-I (08 Contact hours)

Environmental Analysis of water and waste water: General aspects, error and quality control.

Water Analysis Methods: Classical and Spectrophotometry (Absorption Spectrophotometry, Atomic absorption and Emission Analyses). Electrochemical methods and Ion chromatography. Analytical methods for determining dissolved oxygen, BOD and COD, Choice of methods for determining trace metals (As, Cd, Hg, Pb and Se).

Unit IV Environmental Analysis-II (08 Contact hours)

Air pollutants, sampling and methods of analysis (flame photometry, gas chromatography and spectrophotometry).

Determination of oxides of S, N, C, hydrocarbons and organics.

Continuous monitoring instruments as analytical tools for measuring air pollutants: NDIR, GC-MS, Chemiluminescence and Spectrophotometry.

Books Recommended

1. Textbook of Soil Chemistry; L. Bhattacharya; Discovery Publishing House; 2011.
2. Chemistry of the Soil; 2nd ed.; Firman E. Bear; Oxford; 1984.
3. Environmental Chemistry; Nigel. J. Bunce; Wurez Publishers; 1991.
4. Environmental Chemistry; 2nd edn; Colin Baird; Freeman & Co; 1991.
5. A Textbook of Environmental Chemistry; O. D. Tyagi & M.Mehra; Anmol Publishers; 1990.
6. Environmental Chemistry; A. K. De; Wiley Eastern; 1995.
7. Environmental pollution Analysis; S. M. Khopkar; Wiley Eastern.
8. Environmental Chemistry; S. E. Manahan; Lewis Publishers;2000

Course No: CH15209GE
Title: Separation Techniques (02 Credits)

Max. Marks: **50** ***Duration:*** **32** *Contact hours*
End Term Exam: 40 *Marks.* ***Internal Assessment****: 10 Marks*

Unit I Introduction to Separation Techniques

Introduction to sample pretreatment. Sample Preparation: Grinding, homogenization and drying of the sample. Dissolution and digestion of insoluble species. General theory of separation efficiency. Classification of separation techniques: Separation based on size, mass or density, complexation, Change of state and partitioning between phases.

Extraction: Solvent extraction technique, Solid Phase Extraction (SPE) Solid Phase Micro Extraction (SPME). Liquid – liquid extractions, Extraction of Inorganic analytes. Derivatisation, Supercritical fluid extraction.

Unit II Chromatographic procedures for preliminary separations

Fundamentals of Chromatography. Classical and Kinetic theories. Qualitative and quantitative analysis using Chromatographic methods. Basic principles of adsorption, liquid – liquid, liquid – solid, ion exchange and molecular exclusion Chromatography.

Unit III Chromatographic Techniques-I

Theory and applications of Paper Chromatography, Thin layer Chromatography, Column Chromatography, Gas Chromatography , Liquid Chromatography and High Performance liquid Chromatography.

Ion Exchange Chromatography. Classical and High performance techniques. Size Exclusion Chromatography, Super Critical Fluid Chromatography. Affinity and Chiral Chromatographic Techniques.

Unit IV Chromatographic Techniques-II

Multidimensional chromatographic techniques involving thin layer, liquid and gas chromatography. Coupling of Chromatographic and Spectroscopic techniques: GC-MS, GC-FTIR, LC-MS and LC-NMR.

Classical Electrophoresis, Gel and Capillary

Electrophoresis: Introduction classical electrophoresis : Factors affecting ion migration. Principle and application of gel and capillary electrophoresis. Introduction and application of high performance capillary electrophoresis and capillary electro chromatography.

Field Flow Fraction (FFF): Principles of separation, sub-techniques of FFF. Applications.

Books recommended

1. Analytical Chemistry, 2nd Ed. , R. Kellner , J.M. Mermet, M.Otto, M. Valcarcel and H.M. Widmur; Wiley (VCH) 2004.
2. Modern Chemical Techniques; CB. Faust; RSC- 1998.
3. Principles and Practice of Analytical Chemistry; F.W. Fifield and D. Kealey; Blackwell Publishing – 2004.
4. Modern Analytical Chemistry; David Harrey ; McGraw Hill – 2000
5. Fundamental of Analytical Chemistry, 8th edn; Skoog, West Hollar and Crouch , Cengage learning (Brooks/cole) – 2004.

Course No: CH15210OE
Title: Chemistry in Everyday Life-II (02 Credits)

Max. Marks: **50** ***Duration:*** **32** *Contact hours*
End Term Exam: 40 *Marks* ***Internal Assessment****: 10 Marks*

Unit I Nutrition (08 Contact hours)

Digestive Processes: Breaking down of larger molecules into smaller molecules undergoing metabolism like carbohydrates , Proteins, fats and Vitamins. Aerobic and Anaerobic Metabolism of Carbohydrates. Role of Fat in Animal Metabolism.

Energy value of Nutrients: Fats and oils, sweets, vegetables and fruits. Counting of energy calories. Per day energy requirements.

Unit II Agro Chemicals: (08 Contact hours)

Composition and properties of soil, Inorganic and Organic components of soil.

Plant nutrients: Secondary and micro nutrients and their functions.

Fertilizers: Inorganic and Organic fertilizers.

Insecticides, Pesticides and herbicides, Environment and health problems with synthetic pesticides.

Alternate method of insect control: Pheromones , Hormones and Biological control.

Neem: The World's Pharmacy.

Unit III Ceramics (08 Contact hours)

Ceramics**:** Composition, structure and properties of ceramics. How to make ceramics.

Silicate Ceramics: Potteries and Clay products. Glass (composition of various glasses),

Cements**:** Composition of Portland cement.

Unit IV Forensic Chemistry (08 Contact hours)

Introduction. History of forensic science, Theory of forensic analysis. Fingerprint development, Ninhydrin, Silver Nitrate and Phenolphthalein reactions. Cyanoacrylate and Luminol Tests. Alcohol Detection. Hair, Urine and Blood Analysis. DNA fingerprinting. Super glue fuming.

Books Recommended

1. Text book of Engineering Chemistry by S. S. Dara, S.S. Umare (S. Chand and Co). 2013.
2. Engineering Chemistry by M. M. Uppal. & S. Bhatia. (Khanna Publishers).
3. Chemistry in Engineering and Technology by J. C. Kuricose & J. Rajaram (Tata McGraw Hill). 1984
4. General Organic and Bio-chemistry by Bettelheim and Brown. (Campbell books/cole) – 2009.
5. Forensic Chemistry by Suzana Bell (Pearson Prentice-Hall)- 2006
6. Forensic Chemistry Handbook by Lawrence Kobilmisky (John Wiley & Sons Inc.) – 2012.
7. http:// www.aafs.org.
8. http://www.fbi.gov.