**Name of the Program: M.Sc Chemistry**

**Humanities and Social Sciences**
**HSS**

**21UC1203 Design Thinking and Innovation**

**L-T-P-S: 0-0-4-0** **Credits: 2** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | BTL |
|---|---|---|
| CO1 | Understand the importance of Design thinking process for contextualized problems | 2 |
| CO2 | Analyze, define, and ideate for solutions | 4 |
| CO3 | Develop and test the prototype made | 3 |
| CO4 | Explore the fundamentals of entrepreneurship skills for transforming the challenge into an opportunity | 2 |

**Syllabus**

Design thinking an overview, Design Thinking for Contextualized Problem-Solving: Problem Selection/Definition Need for Cultural Relevance (Time, Space, and Environment). Empathy: definition, Empathic research: framing interview questions, focus groups, procedure to conduct skilled interviews, Insights from Empathetic research, define: Developing user personas, nuggets from insights, laying customer journey maps, POV statements and POV questions to define user needs. Ideate: Techniques to generate, shortlist and evaluate Ideas: Rapid Estimation form and Solution concept form. Prototyping and Testing: Products vs. Services, Rough Prototypes, Testing Techniques, User Experience High-Fidelity Prototypes. Entrepreneurial Innovation: Innovation Management, Business Model Basics, Financial Estimation, Pitch Decks, IPR Considerations.

**Reference books**

1. Michael Lewrick, Patrick Link & Larry Leifer: The Design Thinking *Play Book.* Wiley Press: 2018

## PROFESSIONAL CORE

**20CY5101 – THEORETICAL CHEMISTRY-I**

**L-T-P-S: 4-0-0-0** **Credits: 4** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Describe symmetry elements, operations, and groups by representing them in matrices | 1,2 | 3 |
| CO2 | Employ the basic principles of Electronic Spectroscopy & Molecular Spectroscopy | 3 | 3 |
| CO3 | Employ the basic principles of Infrared spectroscopy | 1,2 | 3 |
| CO4 | Employ the basic principles of Raman spectroscopy | 1,2 | 3 |

**Syllabus**

**Symmetry and Group theory in Chemistry***:* Symmetry elements & operations, group, subgroup, relation between order of a finite group and its subgroup. Point group of symmetry. Schon files symbols, representation

of groups by Matrices (representation for Cn, Cnv, Cnh, Dn etc. groups to be worked out, explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use, Application of group theory in IR and Raman spectroscopy **Electronic Spectroscopy & Molecular Spectroscopy:** Introduction to spectroscopy-Classification based on absorption-Emission-Importance-Characterization of electromagnetic radiation -Beer-Lambert's law-deviations from Beers Law-Instrumentation-Applications-Energy levels, molecular orbital's, vibronic transition, vibrational progressions and geometry of the excited sates, Franck-Condon principle. Emission spectra; radioactive and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra. **Infrared spectroscopy**: Basics of IR spectroscopy- Units of frequency wavelength- wave number-molecular vibrations-factors influencing vibrational frequencies-IR spectrometer, characterization techniques. Harmonic oscillator, vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths, anharmonicity Morse potential energy diagram. PQR branches, born– Oppenheimer approximation, selection rules, overtones, hot bands Application **Raman spectroscopy:** Introduction –Principle-Classical and quantum theories of Raman effects, pure rotational, vibrational, and Vibrational – rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman Spectroscopy (CARS)-Application. **Mass spectrometry:** Basic Principles: instrumentation: mass spectrometer, isotope abundances; the molecular ion, metastable ions-Fragmentation of small molecules. **Mossbauer Spectroscopy**: Principle, Experimental Considerations and Presentation of the Spectrum - Isomer Shifts – Quadrupole splitting and Magnetic hyperfine splitting – Selection Rules. Applications-Iron Compounds: Low-spin and High-spin Fe (II) and Fe (III) Complexes - π-bonding Effects in Iron complexes - Diamagnetic and Covalent Compounds-Iodine Compounds: Isomer Shifts of $I^{127}$ and $I^{129}$ – Applications to Alkali metal iodides and Molecular Iodine.

**TEXTBOOKS:**


1. Introductory Group Theory for Chemists – George Davidson
2. Group theory for chemistry – A. K. Bhattacharya
3. Molecular spectroscopy by B. K. Sharma
4. Vibrational Spectroscopy by D. N. Sathyanarayana New Age Int. Pub.
5. Spectroscopy by Aruldas.
6. Chemical Analysis by H. A. Laitinan and W. E. Harris, McGraw Hill.
7. Symmetry and Spectroscopy of Molecules- K. Veera Reddy, New Age International Limited Publishers.
8. Fundamentals of Molecular spectroscopy: by C. N. Banwell


**20CY5102– INORGANIC CHEMISTRY – I**

**L-T-P-S: 4-0-6-0 Credits : 7 Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Predict the shapes of molecules, illustrating the bonding models and applying them to simple molecules | 1,3 | 3 |
| CO2 | Illustrate the structures, reactivities and chemistry of non-transition elements | 1,2 | 3 |
| CO3 | Illustrate the bonding models, structures, reactivities, and applications of coordination complexes | 1,3 | 3 |
| CO4 | Illustrate spectral and magnetic properties, color, and analytical applications of transition metal complexes | 1,2,6 | 3 |
| CO5 | Advanced laboratory procedures used in inorganic synthesis, identification, | 1,3,6 | 3 |

| | | | |
|---|---|---|---|
| | and characterization of small molecules. The design and application of an analysis related to a question of relevance based on experience in the laboratory and research of the scientific literature. Laboratory safety protocols. | | |

**Syllabus**

**Structure & Bonding**: Shapes of molecules (VSEPR Theory, Bent's rule), Valence Bond Theory, Molecular Orbital Theory in explaining the structures of simple molecules [homonuclear diatomic ($H_2$, $H_2^+$, $He_2$, $He_2^{2+}$, $Li_2$, $Be_2$, $B_2$, $C_2$, $N_2$, $O_2$, $F_2$), heteronuclear diatomic (HF, CO), and polyatomic molecules ($H_3$, $H_2O$)] – role of p and d orbitals in pi bonding. **Chemistry of non-transition elements**: Preparation, structure, and reactions of boranes, carboranes, metallo carboranes, boron–nitrogen ($H_3B_3N_3H_3$), phosphorus–nitrogen ($N_3P_3Cl_6$), sulfur-nitrogen ($S_4N_4$, $(SN)_x$) cyclic compounds, interhalogens, pseudo halogens and silicates. Electron counting in boranes – Wades rules (Polyhedral skeletal electron pair theory). **Chemistry of transition metal compounds**: Bonding in Transition metal complexes: Valence Bond theory, Limitations of VBT, Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies, Spectrochemical series, Jahn – Teller effect, nephelauxetic effect, ligand field theory –Applications. **Electronic spectra of transition metal complexes**: Term symbols – Russell – Sander's coupling – derivation of term symbols for various configurations. Spectroscopic ground states. Selection rules, break-down of selection rules. Orgel and Tanabe-Sugano diagrams for d1 – d9 octahedral and tetrahedral transition metal complexes of 3d series – Calculation of Dq, B and β parameters. Charge transfer spectra. Magnetic properties of transition metal and inner transition metal complexes – spin and orbital moments – quenching of orbital momentum by crystal fields in complexes.

**Laboratory Component:**

**I. Qualitative Analysis**:

Semi- micro analysis of six radical mixtures (containing interfering radicals as well as less familiar cations)
Interfering anions: Oxalate, phosphate, borate, chromate.
Less familiar Cations: Molybdenum, zirconium, vanadium, thallium, uranium. (Minimum three Mixtures)

**Chromatography.**

Separation and identification of components of a mixture by paper chromatography. (at least one experiment)

**TEXTBOOKS:**

1.Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson, IV Edition, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III Edition, Harper International Edition, 1983.
3. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd., New Delhi.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press, 5th edition.
5. Concise Inorganic Chemistry by J. D. Lee, Oxford University Press; Fifth edition, Wiley India edition.

**20CY5103 – ORGANIC CHEMISTRY–I**

**L-T-P-S: 4-0-6-0 Credits : 7 Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO No. | Course Outcome (CO) | PO | Blooms Taxonomy Level (BTL) |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Describe the structure and reactivity of chemical constituents of various reaction processes. | 1 | 3 |
| 2 | Apply Nucleophilic Substitution reaction mechanism in the synthesis of desired organic entities. | 1,2 | 3 |
| 3 | Categorize the organic chemical species with respect to their spatial orientation of the groups or atoms attached with them. | 1 | 3 |
| 4 | Apply free radical reactions pathways to develop new and notable organic compounds. | 1,2 | 3 |
| 5 | Derive the necessary pathways to identify the chemical composition in the given binary mixture and the synthesis of organic molecules. | 1,2,3 | 3 |

**Syllabus:**

Nature of Bonding in Organic Molecules**:** Localized and delocalized chemical bonding, conjugation, hyper-conjugation, resonance, tautomerism. Huckel's rule- Aromaticity in benzenoid and non-benzenoid compounds, alternant, and non-alternant hydrocarbons, annulenes, fullerenes metallocene's, homo-aromaticity, anti-aromaticity. Basic mechanistic concepts-kinetic versus thermodynamic control-Hammond's postulate and Curtin-Hammett principle. **Organic reactions-**Reactive intermediates-generation, structure, stability, and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity-resonance and field effects, steric effect, quantitative treatment. Hammett equation and linear free energy relationship-substituent and reaction constants-Taft equation. **Aliphatic Nucleophilic substitution:** SN2, SN1, mixed SN1 and SN2, SET mechanisms. Reactivity- effects of substrates, attacking nucleophiles, leaving groups and reaction medium. Common carbocation rearrangements – primary, secondary, and tertiary. The neighboring group participation (NGP) -a chimeric assistance, NGP by $\sigma$ and $\pi$- bonds, phenonium ions, norbornyl and norbornenyl systems, Classical and nonclassical carbocations, NGP by halogens and heteroatoms (O, N, S). SNi and SN2 mechanisms-Nucleophilic substitution at an allylic, and vinylic carbons. **Aromatic Nucleophilic Substitution:** The SNAr, SN1, benzyne and SRN1mechanisms. Reactivity - effect of substrate, structure, leaving group and attacking nucleophile. Von Richter, Sommelet - Hauser and Smiles rearrangements**. Stereochemistry:** Stereoisomerism-Stereoisomers Classification-Configuration and conformation. Molecular three-dimensional representations: Wedge, Fischer, Newman and Saw-horse formulae, their description, and interconversions. Optical isomerism: Molecular Symmetry and Chirality-Cahn-Ingold-Prelog rules R, S-nomenclature, stereoisomerism resulting from more than one chiral center, meso and pseudo-asymmetric compounds. Axial Chirality-Stereochemistry of allenes spiranes-biphenyl derivatives and atropisomerism. Planar chirality-Ansa compounds and trans-cycloalkenes-Helicity-Helically chiral compounds. geometrical isomerism- E, Z-nomenclature-physical and chemical methods of determining the configuration of geometrical isomers-Stereoisomerism in 3, 4 and 5-membered cyclic compounds. **Free Radical Reactions:** Introduction-types of free radical reactions and their detection. Free radical substitution-mechanism at aromatic substrates, free radical addition, free radical rearrangement. Reactivity of the attacking radicals-the effect of solvent on reactivity. Allylic halogenation (NBS)-oxidation of aldehydes to carboxylic acids-auto-oxidation, Radical coupling -arylation of aromatic compounds by diazonium salts-Sand Meyer reaction-Hunsdiecker reaction.

**LAB COMPONENT:**

I) **Identification** of two functional groups in the given organic mixture (Minimum five Mixtures)-Preparation of two solid derivatives of given compounds and reporting the melting points of derivatives

II) **Preparations:** I) Aspirin ii) Acetanilide iii) p-Bromo Acetanilide iv) Iodoform v) Benzoic acid vi) p-Nitroaniline vii) Benzophenone

**TEXTBOOKS:**

1. Organic Chemistry by Clayden et al., Oxford University press.
2. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley
3. Organic Chemistry Paula Yarkanis Bruis, John Wiley.
4. Advanced Organic Chemistry, F.A. Carey, and R.J Sundberg, Plenum.
5. Structure and Mechanism in Organic Chemistry C. K. Inglod, Cornell University Press.
6. Green Chemistry: Theory and Practice. P.T. Anastas and J.C. Warner. Oxford University Press.
7. Green Chemistry: Introductory Text. M. Lancaster Royal Society of Chemistry
8. Stereochemistry, P. S. Kalsi, Wiley Eastern.
9. Reaction Mechanism in Organic Chemistry by Mukherjee Sirigh, NTerniitarr, Indiar
10. A guidebook to mechanism in Organic Chemistry by Peter Sykes, ELBS.

**Reference Book for Lab:** Vogel Textbook for Organic Chemistry

**20CY5104 – PHYSICAL CHEMISTRY – I**

**L-T-P-S: 4-0-6-0** **Credits : 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Utilize the concepts of Classical thermodynamics & laws of thermodynamics | PO-1, PO-2 | 3 |
| CO2 | Develop the applications of Surfactants and Macromolecules | PO-2 | 3 |
| CO3 | Discuss the different aspects of kinetics of the types of reactions. | PO-2,3,4 | 3 |
| CO4 | lize the concepts of photo chemistry & luminescence | PO-2,3,4 | 3 |
| CO5 | An ability to analyze, generate experimental skills towards the industrial applications. | PO-1,2 | 3 |

**Syllabus:**

Thermodynamics: Chemical equilibrium- effect of temperature on equilibrium constant-Van't Hoff equation. Partial molar quantity- different methods of determination of partial molar quantity. Chemical potential- Phase rule and its derivation, Gibbs-Duhem equation, Duhem- Margules equation, Classius-Clapeyron equation. Nernst heat theorem. Third law of thermodynamics- Determination of the absolute entropy- Apparent exceptions to Third law of thermodynamics. Micelles and Macromolecules: Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization- phase separation and mass action models, solubilization, micro emulsion, reverse micelles. Polymers- Definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization. Molecular mass- Number and mass average molecular mass, molecular mass determination- Osmometry, viscometry, diffusion, and light scattering methods. Sedimentation, chain configuration of macromolecules, calculation of average dimensions of various structures. Chemical Kinetics: Theories of reaction rates- Collision theory- Limitations, Transition state theory. Effect of ionic strength- Debye Huckel Theory-Primary and secondary salt effects. Effect of dielectric constant, effect of substituent, Hamett equation -limitations- Taft

equation. Consecutive reactions, parallel reactions, opposing reactions (Uni molecular steps only, no derivation). Specific and general acid-base catalysis. Skrabal diagram. Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods- temperature jump and pressure jump methods.

Photochemistry: Electronic transitions in molecules, Franck-Condon principle. Electronically, excited molecules-singlet and triplet states, spin-orbit interaction. Quantum yield and its determination. Actinometry. Derivation of fluorescence and phosphorescence quantum yields. Quenching effect- Stern Volmer equation. Photochemical equilibrium and delayed fluorescence- E type and P type. Photochemical primary processes, types of photochemical reactions-photo dissociation, addition, and isomerization reactions with examples.

**List of Experiments:**

1. Determination of rate constant of the oxidation of iodide ion with persulphate ion.
2. Relative strengths of acids by studying the hydrolysis of ethylacetate / methyl acetate
3. Determination of equilibrium constant of $KI_3 \leftrightarrow KI + I_2$ by partition coefficient method and determination of unknown concentration of potassium iodide.
4. Distribution coefficient of Benzoic acid between Benzene and water.
5. Determination of critical solution temperature of phenol-water system Study of the effect of electrolyte on the miscibility of phenol-water system.

**TEXTBOOKS:**

1. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
2. Physical Chemistry by G.W. Castellon, Narosha Publishing House
3. Physical chemistry by K.L. Kapoor

**REFERENCE BOOKS:**

1. Thermodynamics for Chemists by Samuel Glasstone
2. Chemical Kinetics by K.J.Laidler, McGraw Hill Pub.
3. Photochemistry by R.P. Kundall and A. Gilbert, Thomson Nelson.
4. Introduction to Polymer Science by V.R. Gowriker, N.V.Viswanadhan and J. Sreedhar., Wiley Easter.
5. Micelles - Theoretical and applied aspects by V.Moroi, Plenum publishers.

## 20CY5201 - THEORETICAL CHEMISTRY – II

**L-T-P-S: 4-0-0-0** **Credits : 4** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Demonstrate various molecular spectroscopic terms with their theoretical background | 1,2 | 3 |
| CO2 | Employ Nuclear magnetic resonance spectroscopy to interpret organic molecules | 3 | 3 |
| CO3 | Employ the basic principles of Electron Spin Resonance (ESR)-Spectroscopy and XRD applications | 1,2 | 3 |
| CO4 | Write a small computer code to solve basic chemistry problems | 1,2 | 3 |

**Syllabus**

Motion of molecules-Degrees of freedom -Energy associates with the degrees of freedom Type of spectra-***Microwave spectroscopy***. –Principle-Classification molecules, rigid rotator model, effect of isotopic substitution on transition frequencies, Intensities non-rigid rotator-Microwave spectra of polyatomic molecules.

***Photoelectron Spectroscopy*:** Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, Electron spin chemical analysis (ESCA), chemical information from ESCA, Auger electron spectroscopy. ***Nuclear Magnetic Resonance Spectroscopy:*** **(Proton and Carbon -13 NMR).** Introduction-Principle of NMR-Classical and quantum approach-nuclear spin, nuclear resonance-Chemically & Magnetically equivalence and Nonequivalence protons-The measurement of spectra: Chemical shift: the intensity of NMR signals and integration factors affecting the chemical shifts: shielding-de shielding, spin-spin coupling, (n+1) rule, Pascals triangle, coupling constant, **$^{13}$C NMR**, chemical equivalent and non-equivalent carbons, chemical shift, Applications. **Electron Spin Resonance (ESR)-Spectroscopy-** Theory-Instrumentation-ESR lines and intensity-g-values -factors affecting the ESR lines- Hyperfine interactions. Zero field splitting and Kramer's degeneracy. Applications of ESR for the characterization free radicals and metal compounds. **X-ray diffraction**-Introduction- Instrumentation-principle-Braggs law-Scherrer Formula-Applications. **Laser spectroscopy**- General principles of laser action, features of lasers and population inversion. Examples of some common lasers –solid state, gas and dye lasers. **Computer applications in chemistry-** Importance of Coding-Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Van der Waals equation. Rate constant, Radioactive decay (Half Life), Normality, Molarity and Morality of solutions, Nernst Equation, pH-equation.

**TEXTBOOKS:**


1) Fundamentals of molecular Spectroscopy by 3rd ed., TMH, New Delhi, 1983.
2) Spectroscopy by B.P. Straughan and S. Walker, Vol.3, Chapman Hall, London, 1976.
3) Introduction to Molecular Spectroscopy by G.M. Barrow, McGraw Hill, New York, 1964.
4) Introduction to Photoelectron Spectroscopy by P. K. Ghosh, John Wiley New York, 1989.
5) Spectroscopic Identification of Organic Compounds by P.M. Silverstein, F. X. Wester, 6th ed., Wiley 1998.
6) Organic Spectroscopy by W. Kemp, 3rd Ed., Mac Millon, 1994.
7) Applications of Absorption Spectroscopy of Organic Compounds by J.R. Dyer, Prentice Hall, 1965.
8) Introductory Group Theory for Chemists – George Davidson VOGEL'S (2009) Textbook of Quantitative Chemical Analysis- Pearson, 6th Edin.
9) Basics of computers for Chemists, P. C. Jurs.


## 20CY5202 – INORGANIC CHEMISTRY-II

**L-T-P-S: 4-0-6-0** **Credits : 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO | Course outcome (CO) | PO | BTL |
|---|---|---|---|
| 1 | Analyze the various reaction mechanisms of coordination complexes | PO-1, 3 | 4 |
| 2 | Demonstrate structure and bonding of d-block organometallic complexes | PO-1, 3 | 3 |
| 3 | Predict the thermodynamics of complex formation and properties of acids and bases in aqueous medium | PO-1, 4 | 3 |
| 4 | Determine structures of metal clusters, categorize the reactions of d-block organometallic complexes, catalysis | PO-1, 3 | 4 |
| 5 | Perform chemical reactions to prepare inorganic complexes and analyze samples for quantitative determinations. | PO-1,6 | 4 |

**Syllabus**

**Reactivity of coordination complexes**: Kinetics of reactions – inert and labile complexes, associative, dissociative and interchange mechanisms – ligand substitution reactions in octahedral and square planar

complexes, acid and base hydrolysis reactions, electron transfer reactions – inner and outer sphere electron transfer mechanisms. **Metal Ligand equilibria in solution**: Thermodynamics of complex formation in aqueous medium – stepwise and overall formation constants – factors affecting formation constant – determination of formation constant – chelate and macrocyclic effects; isomerism and chirality of coordination complexes – concepts of acids and bases in gas phase and effect of solvation – hard and soft acid base principle. **Organometallic complexes of d-block element** :16 and 18 electron rules – synthesis, structure, and bonding of complexes with sigma and pi donor ligands ($H^-$, $H_2$, alkane, phosphine, $N_2$, CO, NO, allyl, alkene, alkyne, cyclopentadiene, benzene, cyclo octatraene etc.) – carbenes, carbynes and metallocenes. **Organometallic reactions and catalysis**: ligand substitution, addition and elimination reactions, migratory insertion reaction in organometallic complexes, metal-metal bonds, carbonyl, and non-carbonyl clusters, isolobal analogy, application of Wade's rule, metal cluster compounds, Zintle ions, Chevrel phases. Catalysis: Homogeneous (Hydrogenation, hydroformylation, acetic acid synthesis, metathesis, and olefin oxidation) and heterogenous (Fischer-Tropsch reaction, Ziegler-Natta polymerization, Haber process).

**Laboratory Component:**

***Preparation of the coordination complexes***

potassium trisoxalato ferrate (III) – mercury (II) tetrathiocyanatocobaltate (II) – tris thiourea copper (I) sulphate – *cis* and *trans* potassium diaquodioxalato chromium (III) – hexa ammine cobalt (III) chloride – nitro and nitritopentaammine cobalt (III) chloride.

***Quantitative inorganic analysis***

- Determination of $Zn^{2+}$ with potassium ferrocyanide.
- Determination of $Mg^{2+}$, $Ni^{2+}$ and hardness of water using EDTA.
- Determination of $Fe^{3+}$ by photochemical reduction.
- Determination of chloride by argentometric titration using $K_2CrO_4$.
- Determination of $Ni^{2+}$ using dimethyl glyoxime, $Cu^{2+}$ using ammonium thiocyanate, $Zn^{2+}$ using diammonium hydrogen phosphate.

**TEXTBOOKS**


1. Shriver and Atkins' Inorganic Chemistry by Atkins, Overton, Rourke, Weller, Armstrong and Hegerman; Fifth edition, Oxford university press.
2. Inorganic chemistry by Sharpe and Housecroft, Fourth edition, Pearson.
3. Inorganic chemistry: principles of structure and reactivity by Huheey, Keiter, Keiter and Medhi; Fourth edition, Pearson.
4. Advanced inorganic chemistry by Cotton, Wilkinson, Murillo, and Bochmann; Sixth edition, Wiley.
5. Vogel's textbook of macro and semi-micro qualitative inorganicanalysis by G. Svehla, Fifth edition, Longman.
6. Vogel's textbook of quantitative inorganic analysis by Jeffery, Bassett, Mendham, and Denney, Fifth edition, Longman.


**20CY5203–ORGANIC CHEMISTRY–II**

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO No. | Course Outcome (CO) | PO/PSO | Blooms Taxonomy Level (BTL) |
|---|---|---|---|
| 1 | Derive the Electrophilic addition reaction mechanisms of C=C compounds, the relationship among substitution and addition reactions. | PO2, PO3, PO4, PO5, PO6, PO7 | 3 |
| 2 | scribe the types of elimination reactions and their mechanisms | PO2, PO3, PO4, PO5, PO6, PO7 | 3 |

| | | | |
|---|---|---|---|
| 3 | Apply various reaction pathways, addition to Carbon-Hetero Multiple Bonds to develop new and notable organic compounds. | PO2, PO3, PO4, PO5, PO6, PO7 | 3 |
| 4 | Differentiate the Alkaloids and Terpenoids by their unique properties, recent trends and implication of Green and Nano-chemistry | PO2, | 3 |
| 5 | ability to analyze, generate experimental skills towards the industrial applications. | PO3, PO4, PO5, PO6 | 3 |

**Syllabus:**

**Reaction mechanism:** Electrophilic addition to carbon-carbon double bond: Stereoselective addition to carbon-carbon double bond; anti addition-Bromination and epoxidation followed by ring opening-Syn addition of OsO4 and KMnO4. Aliphatic Electrophilic Substitution: Bimolecular mechanism-SE2 and SE1. SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effects of substrate, leaving group and the solvent polarity on the reactivity. Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, hipso-attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling-Vilsmeir reaction, Gattermann-Koch reaction. **Elimination reactions**: Types of Elimination reactions-$E_2$, $E_1$, $E_{1CB}$-mechanisms. Orientation and stereoselectivity in $E_2$ eliminations-Bredt's rule, Saytzeff's rule and Hofmann's rule. Pyrolytic syn eliminations-Pericyclic reactions, Factors influencing the elimination reactions-Elimination Vs substitution. Additions involving electrophiles, nucleophiles, and free radicals-Markovnikov's rule, Kharash or peroxide effect (anti-Markovnikov's rule). Addition to Carbon-Hetero Multiple Bonds**:** Grignard reagents, organo-zinc and organo-lithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanisms-metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles. Carbon-Carbon bond forming reactions (condensation) involving enolates. Named reactions-Aldol, Diels-Alder reaction, Knoevenagel, Mannich, Benzoin, Perkin, Oppenauer oxidation, Clemmensen reduction, Birch reduction, Michael addition, and Stobbe reactions. Hoffmann, Claisen and Favorsky rearrangements, Hydroboration. **Green Chemistry:** Introduction-Basic principles of Green Chemistry, Green catalysis, Bio catalysis, Examples of Green Reactions-Synthesis of ibuprofen, clean Fischer-Indole synthesis comparison with conventional method. **Natural Products:** Alkaloids-General methods of extraction and isolation of natural products, classification based on nitrogen heterocyclic ring, structure elucidation and synthesis: Atropine, Papaverine and Quinine. Terpenoids-Classification of terpenoids, isolation of lower terpenoids, Isoprene, special isoprene rule and Biogenetic Isoprene rule. Structure determination and synthesis: Terpineol, Farnesol, Camphor and Abietic acid. **NanoChemistry-**Introduction-Carbon Nano tubes: Structure of single and multiwalled carbon nano tubes, synthesis-solid and gaseous carbon-based production technique, synthesis with Controlled orientation, Growth mechanism (catalyst free growth & catalyst activated growth) of carbon nano tubes-applications.

**LAB COMPONENT:**

I) **Identification** of two functional groups in the given organic mixture (Minimum five Mixtures)-Preparation of two solid derivatives of given compounds and reporting the melting points of derivatives

II) **Preparations:** i) Aspirin ii) Acetanilide iii) p-Bromo Acetanilide iv) Iodoform v) Benzoic acid vi) p-Nitroaniline vii) Benzophenone

**Reference Book for Lab:** Vogel Textbook for Organic Chemistry

**REFERENCE BOOKS:**


1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey, and R.J Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry C.K.Inglod, Cornell University Press.

4. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Modern Organic Reactions, H.O. House, Benjamin.
6. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic.
7. Stereochemistry, P.S.Kalsi, Wiley Eastern.
8. Textbook of Organic Chemistry, M.C. Murry
9. Organic Chemistry Vol. I (Sixth Edn.) and Vol. II (Fifth Ed.,) by IL finar ELBS.
10. Advanced organic chemistry by Jerry March (4th Edition) Wiley Eastern.
11. Chemistry of Natural Products, K.W.Bentley, Stereochemistry of carbon compounds by E.Eliel, John Wiley & Sons, Inc. Stereochemistry of Organic compounds by D. Nasipuri, Chemistry of Natural products by P.S. Kalsi Kalyani Publishers. 1983

**20CY5204 – PHYSICAL CHEMISTRY-II**

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Account for the basic principles and concepts of quantum chemistry. | PO-1,2 | 3 |
| CO2 | Make use of adsorption process and its mechanisms on the *surfaces* | PO-1,2,3 | 3 |
| CO3 | Discuss Electrochemistry of electrode electrolyte interface | PO-1,2,3 | 3 |
| CO4 | Utilize the concepts of Classical thermodynamics & laws of thermodynamics | PO-1,4,5 | 3 |
| CO5 | An ability to analyze, generate experimental skills towards the industrial applications. | PO-2,6 | 3 |

**Syllabus:**

**Quantum Mechanics:** Introduction to quantum mechanics. Schrödinger wave equation. Time-independent and time dependent Schrödinger wave equations and the relation between their solutions. Eigenfunctions and Eigenvalues. Physical Interpretation of wave function. Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermition operators. Angular Momentum operators and their properties. Commutation of operators. Normalization, orthogonality and orthonormality of wave functions. Average (expectation) values. Postulates of quantum mechanics. Solutions of Schrödinger wave equation for a free particle, particle in a ring, particle in a three-dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrödinger equation to harmonic oscillator, rigid rotator. Eigenfunctions and eigenvalues of angular momentum. Ladder operator method for angular momentum. **Surface phenomena:** Types of adsorption isotherms, Effect of temperature on adsorption, Mechanical adsorption, Estimation of surface area using BET equation, Gibbs adsorption isotherm and its significance, Surface tension and surface energy, Pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Surface film on liquids (electro-kinetic phenomena), Catalytic activity of surfaces **Electrochemistry**: Activity coefficients and ion-ion interactions. Physical significance of activity coefficients, mean activity coefficient of an electrolyte and its determination. Derivation of the Debye-Hückel theory of activity coefficients the electrode-electrolyte interface. The electrical double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model. Electrodics: Charge transfer reactions at the electrode-electrolyte interface. Exchange current density and overpotential. Derivation of Butler-Volmer equation. High field approximation, Tafel equation, Low field equilibrium, Nernest equation. Voltametry-Concentration polarization, experimental techniques. ***Statistical Thermodynamics:*** Fundamentals: Idea of microstates and macro states. Concept of distributions- Binomial & multi-nomial distributions for non-degenerate and degenerate systems, Thermodynamic probability, and most probable distribution. Canonical and other ensembles. Statistical

mechanics for systems of independent particles and its importance in chemistry. Types of statistics: Boltzmann, Bose-Einstein, and Fermi-Dirac statistics. Thermodynamic probability (W) for the three types of statistics. Derivation of distribution laws (most probable distribution) for the three types of statistics. Lagrange's undetermined multipliers. Stirling's approximation, Molecular partition function and its importance. Assembly partition function.

**List of experiments:**

1. Potentiometric determination of Fe (II) with Cr (VI)
2. Potentiometric titration of chloride with silver nitrate.
3. pH-metric determination of strong acid with strong base.
4. Conductometric titration of strong acid with strong base
5. Verification of Beers Law using potassium permanganate/Potassium dichromate.
6. Determination of formulae and stability constant of a metal complex by spectrophotometric method.
7. Verification of Langmuir isotherm. Determination of unknown concentration of acetic acid by studying its adsorption on activated charcoal.

**TEXTBOOKS:**

1. Lowe, J. P. & Peterson, K. Quantum Chemistry Academic Press (2005).
2. McQuarrie, D. A. Quantum Chemistry Viva Books Pvt Ltd.: New Delhi (2003).
3. Mortimer, R. G. Mathematics for Physical Chemistry 2nd Ed. Elsevier (2005)
4. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
5.Physical Chemistry by G.W. Castellon, Narosa Publishing House
6.Physical chemistry by K.L. Kapoor
7. Thomas, J. M. & Thomas, M. J. *Principles and Practice of Heterogeneous Catalysis* John Wiley & Sons (1996).
8. Hamley, I. W. *Introduction to Soft Matter: Polymers, Colloids, Amphiphiles and Liquid Crystals* John Wiley & Sons (2000).

**REFERENCE BOOKS:**

1) Introduction to Electrochemistry by S.Glasstone.
2) Fundamentals of Molecular Spectroscopy by Banwell
3) Spectroscopy by Barrow.
4) *Bowley, Roger and Sanchez, Mariana (2000). Introductory Statistical Mechanics. Oxford University Press*

## 20CY5301- INSTRUMENTAL METHODS OF ANALYSIS-I

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the concepts of excitation spectroscopic methods. | PO-1,2 | 3 |
| CO2 | Understand the basic concepts of rotational and vibrational spectroscopic methods. | PO-3,4 | 3 |
| CO3 | Illustration of the concept of Nuclear magnetic and ESR spectroscopy and their applications. | PO-1,3 | 3 |
| CO4 | Comprehend the basic knowledge of mass spectroscopy and X-ray spectroscopy to characterize the unknown molecules | PO-1,2,5 | 3 |
| CO5 | Ability to analyze chemicals by Instrumental methods | PO-1,5 | 3 |

**Syllabus:**

**UV-Visible Spectroscopy**: laws of absorption, deviation from Beer's law, single and double beam

spectrophotometers-instrumentation, sources of radiation, detectors, qualitative analysis by absorption measurements, general precautions in colorimetric determinations, determination of certain metal ions by using ligands – $Fe^{2+}$, $Fe^{3+}$, $Al^{3+}$, $NH^{4+}$, $Cr^{3+}$, $Cr^{6+}$, $Co^{3+}$, $Cu^{2+}$, $Ni^{2+}$ and anions – $NO^{2-}$, $PO_4^{3-}$ using suitable reagents, simultaneous determinations of dichromate and permanganate in a mixture, spectrophotometric titrations, principle of diode array spectrophotometers. **Spectro fluorimetry:** Theory of fluorescence, phosphorescence, factors affecting the above, quenching, relation between intensity of fluorescence and concentration, instrumentation, application with reference to $Al^{3+}$, chromium salts, fluorescence, thiamin (B1) and riboflavin (B2) in drug samples. **Chemiluminescence:** Introduction, principle, types of Measurement of chemiluminescence, Instrumentation quantitative chemiluminescence Gas phase chemiluminescence's analysis Chemiluminescence titrations, Electro-chemiluminescence. **Infrared spectroscopy:** Units of frequency, wavelength and wave number molecular vibrations, factors influencing vibrational frequencies, instrumentation, sampling techniques, detectors, characteristic frequencies of organic molecules, qualitative and quantitative analysis with reference to (petroleum refinery and polymer industry), selected molecules like CO, $CO_2$, non-destructive IR method for the analysis of CO and other organic compounds, principles of Fourier transform IR. **Mass Spectroscopy:** Principle, basic instrumentation, energetics of ion formation, types of peaks observed, resolution, qualitative analysis, molecular weight determination, quantitative analysis, advantages. **X-ray Spectroscopy:** chemical analysis by X-ray spectrometers, energy dispersive and wavelength dispersive techniques, evaluation methods, instrumentation, matrix effects, applications. **An Introduction to Microscopy (surface characterization techniques)** Limitations of the Human Eye, the X-ray Microscope, The Transmission Electron Microscope, The Scanning Electron Microscope, Scanning Transmission Electron Microscope, Analytical Electron Microscopy, Scanning-Probe Microscopes, the transmission electron microscope.

**List of Experiments:**

1. Determination of alkalinity in a colored effluent using pH metric end point
2. Determination of purity of commercial HCl, $H_2SO_4$, $H_3PO_4$ and $CH_3COOH$ using pH metric end point
3. Determination of Cr (VI) with Fe (II) using potentiometric end point
4. Determination of a mixture of Ce (IV) and V (V) with Fe (II) using potentiometric end point
5. Determination of a mixture of Mn (VII) and V (V) with Fe (II) using potentiometric end point
6. Determination of a mixture of bromide and chloride with $AgNO_3$ using potentiometric end point
7. Determination of KSCN with $AgNO_3$ using potentiometric end point
8. Estimation of aspirin from given tablet by spectrophotometry
9. Determination of Strength of commercial phosphoric acid by potentiometric titrations using standard solution of sodium hydroxide
10. To determine chloride and iodide from given mixture by potentiometry
11. Analysis of Riboflavin from vitamin supplementary capsules / syrup / tablet sample by Photo flurometry
12. Determination of relative strength of acetic acid, chloroacetic acid and trichloroacetic acid through measuring their Ka value by conductivity measurement method
13. Determination of commercial vinegar by potentiometric titration.
14. Determination of boric acid by conductometry.
15. Estimation of micronutrient from food by AAS (any two elements such as Fe, Cu, Zn, Mo, B, Mn)

**TEXTBOOKS:**


1) Instrumental methods of analysis by H.H Willard, Meritt Jr. and J.A Dean
2) Principles of instrumental analysis by Skoog and West
3) Vogel's Textbook of Quantitative Inorganic analysis by J. Basset, R.C Denney, G.H Jefferey and J. Madhan
4) Instrumental methods of analysis by B.K Sarma, Goel Publishing House, Meerut
5) Instrumental methods of Analysis by Chatwal and Anand
6) Instrumental methods of Analysis by Ewing


**REFERENCE BOOKS:**


1) Introduction to instrumental analysis by R. D. Braun, Mc Graw Hill - International edition.
2) Analytical spectroscopy by Kamalesh Bansal, 1st edition.
3) Instrumental methods of chemical analysis by Willard, Dean and Merittee- 6th edition.
4) Analytical chemistry principles by John H. Kenedey- 2nd edition, Saunders college publishing.

5) Spectroscopic identification of organic compounds Fifth Edition by Silvestrine, Bassler, Morrill, John Wiley and sons.
6) Analytical Chemistry by Kellner, Mermet, otto, Valcarcel, Widmer, Second Ed. Wiley –VCH
7) Vogel's Textbook of quantitative Chemical Analysis, sixth Edition by Mendham, Denney, Barnes, Thomas, Pub: Pearson Education.

## 20CY5302- QUALITY CONTROL AND CLASSICAL METHODS OF ANALYSIS

**L-T-P-S: 4-0-0-0** **Credits: 4** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the principles of Quality control in Analytical Chemistry | PO-1,3 | 3 |
| CO2 | Explain the various concepts of decomposition techniques in analysis | PO-1,4 | 3 |
| CO3 | Illustrate, discuss, and apply the various principles behind the various Redox systems involved in the classical Volumetric methods of Analysis. | PO-1,3 | 3 |
| CO4 | Explain the various principles involved in the analysis of Organic Functional Groups | PO-1,2,5 | 3 |

**Syllabus:**

**Characteristics of an analysis:** quality of an analytical procedure, limit of detection, sensitivity, safety, cost measurability, selectivity and specificity, quality control-principles of Ruggedness test, control charts, Youden plot, and ranking test. **Evaluation and reliability of analytical data:** limitation of analytical methods, accuracy, precision, errors in chemical analysis, classification of errors, minimization of errors, significant figures, computations, and propagation of errors. Statistical analysis: Mean deviation, Standard deviation, coefficient of variance, normal distribution, F test, T test, rejection of results, presentation of data. **Quality assurance and management systems:** elements of quality assurance, quality assurance in design, development, production and services, quality and quantity management system, ISO 9000 and ISO 14000 series-meaning of quality, quality process model, customer requirement of quality calibration and testing, statistical process control, process control tools, control chart, statistical quality control, acceptance sampling. Good laboratory practices (GLP) – need for GLP, GLP implementation and organization, GLP status in India. Brief out line of ICH guidelines on drug substances and products. **Decomposition techniques in analysis:** Principle of decomposition and Dissolution. Difference between dissolution / decomposition of Organic and Inorganic substances. Principles of decomposition techniques in Analysis. Decomposition of samples with acids – $H_2O$, HCl, HF, $HNO_3$, $H_2SO_4$ and $HClO_4$ Decomposition of samples by fusion, Alkali Fusion-$Na_2CO_3$, NaOH, Acidic Fusion-Sodium Hydro Sulphate, Sodium Pyro Sulphate Oxidation Fusion-$Na_2O_2$, Sodium Chlorate Reductive Fusion $Na_2CO_3$ + $Na_4BO_4$, Sintering process, Fusion with alkali carbonates, alkali hydroxides, Sodium Peroxide Decomposition of samples by sintering with sodium peroxide, sodium carbonate, Principles of decomposition at high temperatures, high pressures, Principles of Microwave and ultrasonic decomposition techniques. Organic Compounds Principles of solubility of organic compounds, non-polar, polar solvents. Recrystallisation methods and application of solubility and Recrystallisation. Oxidant systems – Principles and applications in analysis Applying the Analytical chemistry of some selected oxidant systems – formal, standard and normal potentials in various media, species responsible for the oxidation properties, stability of the solutions, standardization, requirement for the selections of the oxidants, selection of suitable indicators for Oxidant systems. a) Inorganic Systems Mn (III), Mn (VII), Ce (IV), Cr (VI), V (V), periodate, iodate, b) Organic Systems chloramine-T. Organic Functional group analysis: Classification of functional groups with suitable examples. Determination of: Functional groups imparting acidic nature – thiol, enediol, phenolic hydroxyl. Functional groups imparting basic nature – Aliphatic and Aromatic primary, secondary and tertiary amines – hydrazine derivatives. Functional groups which impart neither acidic nor basic nature – Aldehydes, Ketones, Nitro, Methoxy, Olifinic.

**TEXTBOOKS:**

1. Technical methods of analysis by Griffin, Mc Graw Hill Book Co.
2. Chemical Separation and measurements by D. G Peterseti, John M.Haves Sanders Co.
3. Chemical analysis by H.A Laitinan, Mc Graw Hill Book Co.
4. Newer redox titrants by Berka, Zyka and Vulterin, Pergamon Press
5. Volumetric Analysis, Vol III by I.M Kolthoff and R. Belcher, Interscience Public, New York
6. Vogel's Textbook of Inorganic Quantitative Analysis by J. Bassett et al, ELBS
7. Organic functional groups by S. Siggia

**REFERENCE BOOKS:**

1. Analytical Chemistry, An Introduction by D.A Skoog, D.M West and F.J Holler, Sanders College Publishing, New York.
2. Environmental Management by K.V.S.G Murali Krishna, An Introduction ISO 9000, ISO 1400 Series, Quality Assurance and Good Laboratory Practices by Prof. Y. Anjaneyulu, In Now Publication, New York
3. Quality Assurance in Analytical Chemistry by G.Kateman and F.W Pijpers, John Wiley and Sons, New York
4. Quantitative Chemical Analysis by I.M Kolthoff, E.B Sandel, E.J Meehan, S. Bruckenstein, Macmillan Company, London
5. Decomposition Techniques in Inorganic Analysis by J.Dolezal, P.Povondra, Z.Sulcek

## 20CY5303- APPLIED CHEMICAL ANALYSIS

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the principles, methodology and adoptability various procedures for the analysis of Analysis of Iron, Manganese, Chromite, Phosphate and Aluminium Ores | PO-1,2 | 3 |
| CO2 | Discuss, explain, and illustrate the applications of the general methods of analysis for finished products such as Steel, dolomite, fire clay, four spar and magnesite | PO-1,3 | 3 |
| CO3 | Finding the adoptability by applying the general methods of analysis for Cement, Soaps, Oils, and paints analysis | PO-1,2,4 | 3 |
| CO4 | Explain and apply the various principles involved in the chemical and physicochemical analysis of Organic Functional Groups | PO-1,4,5 | 3 |
| CO5 | Analysis of chemicals by instrumental methods | PO-1,2 | 3 |

**Syllabus:**

Analysis of Ores: General techniques of analysis applied to complex materials - Scope of metallurgical analysis- General methods of dissolution of complex materials - Various chemical methods for the effective separation of the constituents in the complex materials. Analysis of ores: Iron ore- Analysis of the Constituents – Moisture, loss of ignition, Total Iron, ferrous Iron, Ferric Iron, alumina, silica, Titania, Lime, Magnesia, Sulphur, phosphorus, manganese, alkalis, combined water, Carbon in blast furnace, flue dust and sinter. Manganese Ore-Analysis of the Constituents– Total Manganese, $MnO_2$, $SiO_2$, BaO, $Fe_2O_3$, $Al_2O_3$, CaO, P and S Chromite Ore - Analysis of the Constituents-Chromium, $SiO_2$, FeO, $Al_2O_3$ CaO, & MgO. Phosphate rock Ore - Analysis of the Constituents-CaO, $P_2O_5$, F, $SiO_2$, $CO_2$, S, $Na_2O$, $Al_2O_3$, $Fe_2O_3$, Mgo, $K_2O$, Cl, MnO. Organic carbon, Moisture, Loss of ignition. Aluminum Ore (Bauxite)-Analysis of the Constituents-Silica, Alumina, $Fe_2O_3$, Titania, MnO, $P_2O_5$, CaO, MgO, vanadium, zirconium, and alkalis. Analysis of Finished Products: Analysis of steel for C, Si, S, P, Mn, Ni, Cr; Mg and analysis of blast furnace slag. Analysis of refractory materials: fire clay, flour spar, and magnesite Analysis of fluxes - limestone and dolomite. Chemical Analysis of cement-silica, $NH_4OH$ group, ferric oxide, alumina, lime, magnesia, Sulfide Sulphur, $K_2O$,$Na_2O$, free CaO in Cement and Clinker, $SO_3$ and loss on ignition. Analysis of oils- saponification number, iodine number, and acid number. Analysis of soaps - moisture, volatile

matter, total alkali, total fatty matter, free caustic alkali or free fatty acids, sodium silicate, chloride. Analysis of paints-vehicle and pigment, $BaSO_4$, total lead and lead chromate. Assessment of water Quality: Sources of water, classification of water for different uses, types of water pollutants and their effects, Analytical methods for the determination of the following ions in water: Anions: $CO_3^{2-}$, $HCO^{3-}$, $F^-$, $Cl^-$, $SO_4^{2-}$, $PO_4^{3-}$, $NO^{3-}$, $NO^{2-}$, $CN^-$, $S^{2-}$ Cations: $Fe^{2+}$, $Fe^{3+}$, $Ca^{2+,}$ $Mg^{2+}$, $Cr^{3+}$, $As^{5+}$, $Pb^{2+}$, $Hg^{2+}$, $Cu^{2+}$, $Zn^{2+}$, $Cd^{2+}$, $Co^{2+}$. Determination of Dissolved oxygen (D.O), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), standards for drinking water.

**List of Experiments:**

**Water analysis**

(i) Analysis of water for total hardness ($Ca^{2+}$ and $Mg^{2+}$)
(ii) Analysis of water for chloride ($Cl^-$)
(iii) Analysis of water for alkalinity ($CO_3^{2-}$, $HCO_3^-$)
(iv) Analysis of dissolved oxygen (DO) in drinking water and sewage water
(v) Analysis of chemical oxygen demand (COD) in drinking water and sewage water

**Fertilizer analysis**

(i) Analysis of fertilizer for ammonia, nitrate and phosphate

**Analysis of iron ore**

(i) Complete analysis of iron ore
(ii) Analysis of iron ore (with special reference to percentages of Fe (II) and Fe (III) present in the sample)

**TEXTBOOKS:**


1. Handbook of Analytical Control of Iron and Steel Production by Harrison John, Weily 1979
2. Standard methods of Chemical Analysis by Welcher
3. Technical Methods of Analysis, Griffin by Mc Graw Hill
4. Commercial Methods of Analysis by Foster Dee Sneel and Frank M. Griffin, Mc Graw Hill Book Co.
5. Water Pollution, Lalude by Mc Graw Hill
6. Environmental Chemistry by Anil Kumar De, Wiley Eastern Ltd.
7. Environmental Analysis by S.M. Khopkar (IIT Bombay)


## 20CY5310 -ORGANIC SYNTHESIS- I

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

### Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Build carbon-carbon single bond associated molecules (carbenes-carbenoids) | PO-2,4 | 3 |
| CO2 | Develop carbon-carbon double bonds using notable elimination reactions | PO-2,3 | 3 |
| CO3 | Make use of organic polymerization processes | PO-1,5 | 3 |
| CO4 | Understand the applications of organic boranes. | PO-2,4,5 | 3 |
| CO5 | Ability to synthesize organic molecules for general health issues | PO-2,3 | 3 |

**Syllabus:**

Formation of Carbon-Carbon single bounds: alkylation via enolate the enamine and related reactions, umplong (dipole inversion) reactions – the aldol reaction – applications of organo palladium, organo nickel and organo copper reagents, applications of α-thio carbanions, selenocarbonions and sulphur ylides, synthetic applications of carbenes and carbenoids. Formation of carbon-carbon double bonds: Elimination reactions Pyrolytic, syneliminations, sulphoxide-sulphonate rearrangement the witting reaction-alkenes from aryl sulphonyl hydrazones, claisen rearrangement of allyl vinyl ethers. Organoboranes: Preparation of Organobornaes viz hydroboration with $BH_3$-THF, di cyclohexyl borane, disiamyl borane, thexyl borane, 9-BBN and diisopino camphenyl borane, functional group transformations of Organo Boranes-Oxidation, protonolysis and rearrangements. Formation of carbon – carbon bonds viz organo boranes carbonylation, the cyanoborate

process and reaction of alkenyl boranes and trialkenyl borates. Methods of polymerization (a) addition polymerization (b) Condensation polymerization (c) Radical polymerizations (two examples of each method) Reactions of un activated carbon-hydrogen bonds: The Hoffmann Lieffier- Freytag reaction-the Barton Reaction-Photolysis of organic hypo thalites.

**List of Experiments**

| S. No | Name of the Experiment |
|---|---|
| 1 | Synthesis of P- Bromo acetanilide from aniline |
| 2 | Preparation of Aspirin from Methyl salicylate |
| 3 | Preparation of 2,4- Di Nitro Phenol from Chlorobenzene |
| 4 | Synthesis of Anthraquinone from Phthalic anhydride |
| 5 | Synthesis of P- Nitro Aniline from Acetanilide |
| 6 | Synthesis of Benzylic acid from Benzoin |
| 7 | Synthesis of 1,3,5- Tribromo Benzene from Aniline |
| 8 | Synthesis of M- Nitro Aniline from Nitro Benzene |
| 9 | Synthesis of Beta- Naphthol from Naphthalene |
| 10 | Synthesis of Coumarin from Phenol |

**TEXTBOOKS:**


1. Advanced Organic Chemistry-Reactions, Mechanism and Structure by Jerry March, John Wiley.
2. Advanced Organic Chemistry by F.A. Carey and R.J Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry by C.K.Inglod, Cornell University Press.
4. Organic Chemistry by R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Principles of Organic Synthesis by R.O.C Norman and J. M. Coxon, Blackie Academic
6. Stereochemistry by P.S.Kalsi, Wiley Eastern.
7. Textbook of Organic Chemistry by M.C. Murry
8. Organic Chemistry Vol. I (Sixth Edn.) and Vol. II (Fifth Ed.,) by IL Finar ELBS. Chemistry (fifth Edn.,) by Morrison and Boyd, PHI, India.
9. Organic Chemistry (fifth edition) by Francis A. CareyTata Mc Graw Hill publishing company Limited, New Delhi.
10. Reaction Mechanism in Organic Chemistry by Mukherjee Sirigh, N Terniitarr, Indiar
11. Textbook of Practical Organic Chemistry by Vogel


## 20CY5311-NATURAL PRODUCTS AND BIOMOLECULES

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Illustrate the drug metabolic pathways, adverse effect and therapeutic value of alkaloids and microbial metabolites | 1,4 | 3 |
| CO2 | Identify the mechanism pathways of different class of medicinal compounds like terpenoids and steroids. | 1,3,5 | 3 |
| CO3 | Interpret the chemistry of carbohydrates with respect to their pharmacological activity | 1,2,3 | 3 |
| CO4 | Demonstrate the function of proteins, nucleic acids and recognize the importance of amino acids and peptides. | 4,5 | 3 |
| CO5 | Evaluate and carryout independent investigations of plant materials and natural products | 2,3 | 5 |

**Syllabus:**

Occurrence, nomenclature, basic skeleton, stereochemistry, Isolation, Structure determination and synthesis of the following class of natural products from plant, animal and microbial sources and biopolymers. Alkaloids: Morphine, reserpine, and vincristine. Microbial metabolites: Penicillin G, Cephalosporin-O and streptomycin. Terpenes: Forskolin, Taxol, Azadirachtin, Biosynthesis of terpenes. Steroids: Diel's hydrocarbon, Cholesterol, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, and Biosynthesis of Steroids. Carbohydrates: Naturally occurring sugars: Deoxy sugars, amino sugars, branched sugars. Structure elucidation of lactose, D-glucosamine and meso inositol. Structural features and applications of inositol, starch, cellulose, chitin and heparin. Biomolecules: Amino acids, peptides, and proteins: Chemical and enzymatic hydrolysis of proteins to peptides, Secondary, tertiary, and quaternary structure of proteins, amino acid sequencing, α-Amino acids-general properties & synthesis. Synthesis of peptides by Merrifield solid phase synthesis. Nucleic acids: Structure and function of physiologically important nucleotides (c-AMP, ADP, ATP) and nucleic acids (DNA and RNA), replication, genetic code, protein biosynthesis, mutation.

**List of Experiments**

1. Estimation of Hydroxyl group by acetylation or phthalation method
2. Estimation of phenol by bromination method
3. Estimation of aniline by Bromination method
4. Estimation of sugars by using Fehling's method
5. Estimation of Vitamin-C in lime Juice
6. Identification of secondary metabolites present in plant extracts
7. Isolation of Caffeine from tea
8. Isolation of Lycopene from Tomatoes
9. Isolation of Lactose from Milk
10. Isolation of Citric Acid from Lemon
11. Isolation of Limonene from Orange peels
12. Isolation of Piperine from Black Peppercorns

**TEXTBOOKS:**


1. Organic Chemistry by I.L. Finar Vol. I and II, 9th Edition, Pearson, 2009.
2. Medicinal Chemistry by Graham L. Patrick, Oxford University Press, 2005.
3. Textbook of Practical Organic Chemistry by Vogel


## 20CY5312 -ORGANIC SPECTROSCOPY

**L-T-P-S: 4-0-0-0** **Credits: 4** **Prerequisite: NIL**

### Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:

| CO No | Course Outcome (CO) | PO | Blooms Taxonomy Level (BTL) |
|---|---|---|---|
| 1 | Discuss about UV-VISIBLE and IR Spectroscopy and Applications towards deduction of structure of Molecule | 1,2,3 | 3 |
| 2 | Describe about NMR- Spectroscopy and Applications towards deduction of structure of Molecule | 1,2 | 3 |

| | | | |
|---|---|---|---|
| 3 | Discuss the concept of 2D-NMR Spectroscopy and Applications towards deduction of structure of Molecule | 1,2 | 3 |
| 4 | Discuss the Mass Spectroscopy and Applications towards deduction of structure of Molecule | 1,2 | 2 |

**SYLLABUS**

**UV-VISIBLE SPECTROSCOPY:** Various electronic transitions - Effect of solvent on electronic transitions - Ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, and conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds - Ultraviolet spectra of aromatic and heterocyclic compounds - Steric effect in biphenyls. Applications towards deduction of structure of Molecule. **IR SPECTROSCOPY:** Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, Nitrogen compounds and sulphur compounds-Detailed study of Bending vibrations and stretching vibrations- Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams, and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect steric effect on vibrational frequencies, overtones, combination bands and Fermi resonance, Applications towards deduction of structure of Molecule. **NMR SPECTROSCOPY: HNMR**: Nuclear spin - nuclear resonance - Saturation, shielding of magnetic nuclei - Chemical shifts and its measurements - Factors influencing chemical shift – De shielding - Spin-spin interactions - Factors influencing coupling constant 'J' – Classification on (ABX, AMX, ABC, A2B2etc.) - Spin decoupling - Basic ideas about instrument - FT-NMR - Advantages of FT-NMR. Shielding mechanism - Mechanism of measurement - Chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, and amides) - Chemical exchange - Effect of deuteration - Complex spin-spin interaction between two, three, four and five nuclei (First order spectra) - Virtual coupling. Stereochemistry - Hindered rotation - Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra: nuclear magnetic double resonance - Contact shift reagents - Nuclear overhauser effect (NOE). **2D-NMR SPECTROSCOPY:** The separation of Chemical shift and coupling on to two different axes (2D-NMR, Cosy), spin decoupling, the nuclear over hauser effect associating the signal from directly bonded $^{1}H$. $^{13}C$-NMR Spectroscopy: General considerations - Chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon) - Coupling constants. Applications towards deduction of structure of Molecule. **MASS SPECTROMETRY -**Mass Spectrometry Introduction - Ion production - Types of ionization; EI, CI, FD, and FAB - Factors affecting fragmentation - Ion analysis - Ion abundance. Mass spectral fragmentation of organic compounds - Common functional groups - Molecular-ion peak - Metastable peak - Mc. Lafferty rearrangement. Nitrogen rule - Isotope labelling - High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

**TEXTBOOKS:**


1. Spectroscopic methods in Organic Chemistry
2. Fundamentals of molecular Spectroscopy by 3rd ed., TMH, New Delhi, 1983.
3. Spectroscopy by B.P. Straughan and S.Walker, Vol.3, Chapman Hall, London, 1976.
4. Introduction to Molecular Spectroscopy by G.M. Barrow, McGraw Hill, New York, 1964.
5. Introduction to Photoelectron Spectroscopy by P.K.Ghosh, John Wiley New York, 1989.
6. Spectroscopic Identification of Organic Compounds by P.M. Silverstein, F. X. Wester, 6th ed., Wiley 1998.
7. Organic Spectroscopy by W. Kemp, 3rd Ed., MacMillon, 1994.
8. Applications of Absorption Spectroscopy of Organic Compounds by J.R. Dyer, Prentice Hall, 1965.


## 20CY5401-INSTRUMENTAL METHODS OF ANALYSIS-II

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Discuss and understand the principles and instrumentation involved in the Flame photometry. Atomic Absorption Spectrometer, inductively coupled plasma spectrometer and Arc and Spark spectrographic Direct | PO-2, 5, | 3 |

| | | | |
|---|---|---|---|
| | analysis. | | |
| CO2 | Discuss and apply the various principles and methodology in TGA, DTA and DSC | PO-1,3 | 3 |
| CO3 | Discuss and apply the principles and methodology involved in Voltametry, polarography, Anode stripping voltammetry and Coulometry. | PO-1,3,5 | 3 |
| CO4 | Discuss the principles and methodology in assaying the analytes using Ion Selective Electrodes and Radio chemical methods | PO-2,3,5 | 3 |
| CO5 | Ability to analyze chemicals by Instrumental methods | PO-3,5 | 3 |

**Syllabus:**

**Electro analytical Methods of Analysis:** Polarographic principles, Instrumentation (different types of microelectrode such as dropping mercury electrode, the static drop mercury electrode, rotating disc and ring disc electrode, cell for polarography, reference and counter electrode and circuit diagram), polarogram and polarographic currents, charging or capacitive current, role of supporting electrolyte, factors affecting on polarographic wave, Ilkovic Equation, advantages and disadvantages of DME, polarographic maxima and maxima suppressors, interference due to dissolved oxygen, Applications (qualitative analysis, quantitative analysis by calibration curve and standard addition methods), specific examples of analysis–analysis of Cu, Cd, Zn, Pb, etc. from tap water and alloys., problems. **Pulse Polarography:** different types of excitation signals in pulse polarography, Differential pulse polarography, square wave polarography, Stripping method. Voltammetry with ultra-microelectrode, Applications of these techniques Cu and Zn from tap water by differential pulse polarography and by square wave polarography, Vitamin-C by differential pulse polarography **Anode stripping voltammetry:** principle, instrumentation, hanging mercury drop electrode, application in the analysis of Pb and Cd in environmental samples, principle of cathode stripping voltammetry. **Principle of cyclic Voltammetry**, cyclic volta mogram of $K_3[Fe(CN)_6]$, and parathion, criteria of reversibility of electrochemical reactions, quasi reversible and irreversible processes. **Coulometric analysis:** principles of coulometric analysis with constant current, coulometric analysis with controlled potential, applications of coulometric methods for the analysis of cations-As (III), Fe (II) and $I^-$ and $S^{2-}$ by using $I_2$ liberations and $Ce^{4+}$ liberation in solutions **Spectro-Analytical Methods of Analysis: Flame photometry:** theory, instrumentation, combustion flames, detectors, and analysis of Na, K, Ca, Mg etc. **Atomic Absorption Spectrometer:** theory, instrumentation, flame and non-flame techniques, resonance line sources, hollow cathode lamp, instrumentation, chemical and spectral interferences, applications with special reference to analysis of trace metals in oils, alloys and toxic metals in drinking water and effluents. **Inductively coupled plasma spectrometer (ICP-AES, ICP-MS):** principles, instrumentation, plasma, AES detectors, quadrupole mass spectrometers, difference between the two detectors, analysis methods for liquids and solids, applications in the analysis of trace and toxic metals in water, geological and industrial samples **Thermal methods of Analysis:** Thermogravimetry-theory, instrumentation, applications with special reference to $CuSO_4.5H_2O$, $CaC_2O_4.2H_2O$, $CaCO_3$, $(COOH)_2.2H_2O$ Differential thermal analysis-principle, instrumentation, difference between TG and DTA-applications with special reference to the clays and minerals, coals (fuels)**.** Differential scanning calorimetry-principle, instrumentation, applications to inorganic materials like chlorates and per chlorates, ammonium nitrate, organic compounds, and Drugs**. Radio chemical methods of analysis:** detection and measurement of radioactivity, introduction to radioactive tracers, applications of tracer technique, isotope dilution analysis-applications, activation analysis – application, advantages and disadvantages, radiocarbon dating technique

**List of Experiments:**

**Voltammetry**

1. Fabrication of carbon paste electrode.
2. Determination of peak potential of Pb, Cd and Zn using differential pulse voltammetry at carbon paste electrode.
3. Determination of amount Pb present in unknown sample using square wave voltammetry.
4. Determination of amount Cd present in unknown sample using square wave voltammetry.

5. Determination of amount Zn present in unknown sample using square wave voltammetry.

**Spectrophotometry**

1. Spectrophotometric determination of Fe (III) using KSCN.
2. Spectrophotometric determination of phosphate.
3. Spectrophotometric determination of Cr (VI).
4. Spectrophotometric determination of Nitrite.
5. Determination of pKa value of an indicator by spectrophotometry.

**pH-metry**

1. Determination of dissociation constant (pKa) of acetic acid using pH-metry.
2. Determination of dissociation constant (pKa) of acetic acid using point wise calculation
3. Determination of carbonate and bicarbonate in the given mixture by pH-metry.
4. Determination of isoelectric point of amino acids.
5. Determination of ionization constant of amino acids using Irving Rosotti method.

**Conductometry**

1. Determination of halides ($Cl^-$, $I^-$ etc.) using conductometric method.
2. Determination of the degree of ionization and ionization constant of weak electrolytes.
3. Determination of solubility of sparingly soluble salts by conductometric method.
4. Estimation of Aspirin by conductometry.

**Chromatography**

1. Separation of amino acids by TLC.
2. Determination of aspirin by HPLC.
3. Separation of pigments by paper chromatography.
4. Separation of cations and their quantification by ion exchange chromatography.

**Flame photometry**

Determination of Na, K and Li by Flame photometry.

**TEXTBOOKS:**


1) Instrumental methods of analysis by H.H Willard, Meritt Jr. and J.A Dean
2) Principles of instrumental analysis by Skoog and West
3) Vogels Textbook of Quantitative Inorganic analysis by J. Basset, R.C Denney, G.H Jefferey and J.Madhan
4) Instrumental methods of analysis by B.K Sarma, Goel Publishing House, Meerut
5) Instrumental methods of Analysis by Chatwal and Anand
6) Instrumental methods of Analysis by Ewing


**REFERENCE BOOK:**


1) Thermal Analysis by W.Wendtlandt, John Wiley Sons, New York


## 20CY5402-ADVANCED APPLIED CHEMICAL ANALYSIS

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

### Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | To discuss the concepts of analysis of ferrous, non-ferrous metals and allied Fe compounds | PO-2,5 | 3 |
| CO2 | To understand analysis of soil, fertilizer, and fuel for applied purposes. | PO-3,4 | 3 |
| CO3 | To discuss different methods involved in analysis of different gaseous components in air. | PO-1,3 | 3 |
| CO4 | To determine moisture content in drugs and other samples. | PO-2,3,5 | 3 |
| CO5 | Explain the various principles involved in the analysis of Organic Functional Groups | PO-2,4 | 3 |

**Syllabus:**

**Analysis of raw materials:** Analysis of non-ferrous alloys: Brass – Analysis of the constituents – Cu, Zn, Sn, Pb and Fe. Bronze -Analysis of the constituents -Cu, Sn, Zn, Pb and Fe. Solder - Analysis of the constituents – Sn, Pb and Sb. Analysis of Ferro alloys : Ferro silicon - Analysis of the constituents – Si, C, P,S Ferro vanadium- Analysis of the constituents – V, C, P, S. Si, Al. Ferro manganese - Analysis of the constituents – Mn, S, C, P, Si Silico manganese -Analysis of the constituents –Mn, S, C, P, Si Ferro chromium - Analysis of the constituents – Cr, C, Si. **Analysis of Soil, Fertilizer and Fuel:** Analysis of soils: sampling, determination of moisture, total N, P, Si, lime, humus nitrogen, alkali salts, soil absorption ratio. Analysis of fertilizers: ammonical fertilizers, Phosphate fertilizers, Nitrate fertilizers. Analysis of fuels: solid fuels-coal, proximate analysis, ultimate analysis, heating value, grading of coal based on Ultimate Heat Value (UHV). **ASSESSMENT OF AIR QUALITY:** Composition of Pure Air, Classification of Air Pollutants, Toxic Elements Present in Dust, and their Sources – Collection of Air Samples. Sources, Effects, Control of Pollution and Chemical Analysis for the following. Primary Pollutants: Carbon compounds - Carbon monoxide (CO) and Carbon dioxide ($CO_{2)}$. Sulphur compounds- sulphur dioxide ($SO_2$), Sulphur trioxide ($SO_3$) and Hydrogen Sulphide ($H_2S$). Nitrogen compounds - nitric oxide (NO), and nitrogen dioxide ($NO_2$), Hydrocarbons - Aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAH). Particulate matter - Repairable and Suspended particulate matter, Inorganic and Organic particulates. Secondary pollutants - ozone ($O_3$), peroxy acetyl nitrate (PAN), peroxy benzyl nitrate (PBN), Standards for ambient air quality. **Kinetic Methods of Analysis & Non aqueous Titrimetry:** Kinetic methods of analysis: introduction, slow reactions, catalyzed reactions, methods of determination of catalyst concentration, extrapolation method for the determination of catalyst, variable time method, fixed time method, examples for the determination of toxic metals and anions using some typical kinetic reactions. **Non aqueous titrimetry:** Classification of solvents and titrations for non-aqueous titrimetry- Types of reactions – Indicators. Determination of acids Determination of bases Karl-Fisher reagent for the determination of moisture content in drugs and other samples.

**List of Experiments:**

**1. Complexometric titrations**

Analysis of zinc in zinc ore by using EDTA
Analysis of nickel by EDTA
Analysis of limestone or dolomite

**2. Analysis of oils, fats, and soaps**

Analysis of oil for the determination of saponification value, acid value and iodine value
Analysis of soaps for moisture content and total alkali

**3. Analysis of coal**

moisture content
volatile matter
fixed carbon ash content

**TEXTBOOKS:**


1) Chemical analysis by H.A Laitinan, Mc Graw Hill Book Co
2) Standard methods of Chemical Analysis by Welcher
3) Technical Methods of Analysis by Griffin, Mc Graw Hill
4) Commercial Methods of Analysis by Foster Dee Sneel and Frank M. Griffin, Mc Graw Hill Book Co.
5) Environmental Chemistry by Anil Kumar De, Wiley Eastern Ltd.
6) Environmental Analysis by S.M Khopkar (IIT Bombay)
7) Environmental Air Analysis by Trivedi and Kudesia, Akashdeep Pub.


## 20CY5407-ORGANIC SYNTHESIS–II

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Explain the properties of Oxidizing agents and reducing agents | PO-1,4 | 3 |

| | | | |
|---|---|---|---|
| CO2 | strate reaction mechanisms for some organo silane related compounds | PO-2,3 | 3 |
| CO3 | Explain theory and principals involved in Disconnection approach and principals of Phase transfer catalysis | PO-1,3 | 3 |
| CO4 | Explain about the Retrosynthesis and applied to various cyclic organic molecules | PO-1,5 | 3 |
| CO5 | To carryout multistep synthesis of organic molecules | PO-2,4 | 3 |

**Syllabus:**

Organo silanes, Synthetic applications of trimethylsilyl chloride dimethyl-t-butyl silyl chloride, trimethyl silyl cyanide, trimethylsilyl iodide and trimethylsilyl triflate, synthetic applications of silyl carbanion and B-silyl carbonium ions. Oxidations of hydrocarbons, alkenes, alcohols, aldehydes, and ketones. Oxidative coupling reactions using Pb $(OAC)_4$, NBs, $CRO_3$, $SeO_2$, $NinO_2$ Dc- alkoxyl uphonium yields, $KMnO_4$, $OsO_4$, peracids and Ti (III) nitrate. Catalytic hydrogenation (homogeneous and heterogeneous), reduction by dissolving metals. Reduction by hydride transfer -reagents, reduction with hydrazine and diamide, selectivity in reduction of nitroso and nitro compounds, reductive cleavage. Design of Organic Synthesis: Retrosynthesis the disconnection approach-basic principles convergent and linear synthesis. Phase transfer catalysis-Principle and applications.

**Experiments:**

| | |
|---|---|
| 1 | Synthesis of 1- Bromo-2- Bromo Methyl Naphthalene |
| 2 | Synthesis of Sulphanilide from Acetanilide |
| 3 | Synthesis of Hippuric acid |
| 4 | Synthesis of 7- Hydroxy- 4- Methyl Coumarin |
| 5 | Synthesis of 1,3,5- Tri Bromo Benzene |
| 6 | Synthesis of 2,4,6- Tri bromo Aniline |
| 7 | Synthesis of Anthracene- Maleic anhydride adduct |
| 8 | Synthesis of Meta dinitro Benzene |
| 9 | Synthesis of Meta Nitro Aniline |
| 10 | Synthesis of Azalactone |

**TEXTBOOKS:**


1) Some Modern Methods of Organic Synthesis by W. Carothers, Third Edition, Cambridge University Press, Cambridge, 1988.
2) Organic Synthesis: The disconnection approach by S. Warrant John Wiley & sons, New York, 1984.
3) Modern Synthetic Reactions by Herbet O. Horase, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
4) Organic Synthesis viz Boranes by Herbet C. Brown Gray, W. Kramer Alan B. Levy and M. Mark Midland John Wiely &. Sons, New York, 1975.
5) Textbook of Practical Organic Chemistry by Vogel
6) Textbook of Practical Organic Chemistry by Mann & Sunders


## 20CY5408-ADVANCE HETEROCYCLIC CHEMISTRY

**L-T-P-S: 4-0-6-0** **Credits: 7** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | To classify, synthesis and reactivity of simple heterocyclic aromatic and non-aromatic compounds as electron deficient or electron rich and explain their reactivity based on these properties | PO-1,2 | 3 |
| CO2 | ply the aromaticity, reactivity, and synthesis of Five, six membered heterocyclic compounds with two hetero atoms | PO-1,2 | 3 |

| | | | |
|---|---|---|---|
| CO3 | Apply the aromaticity, reactivity, and synthesis of heterocyclic compounds with more than hetero atoms | PO-2,3 | 3 |
| CO4 | Apply the synthesis, structure, reactivity, and stability of larger ring heterocyclics | PO-1,3,4 | 3 |
| CO5 | Ability to synthesize heterocyclic compounds | PO-2,4 | 3 |

**Syllabus:**

Nomenclature (Hantzsch Widman System), spectral characteristics, reactivity, and aromaticity of monocyclic, fused, and bridged heterocycles. Nonaromatic heterocycles. Different types of strains, interactions, and conformational aspects on nonaromatic heterocycles. Synthesis, reactivity, and importance of the following ring systems. Azirines, Oxiranes, Thiiranes, Diazirenes, Diaziridines, Azetidines. Five and six-membered heterocycles with two hetero atoms: Synthesis, reactivity, aromatic character, and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Pyrimidine, Pyrazine, Oxazine, and Thiazine. Heterocycles with more than two hetero atoms: Synthesis, reactivity, aromatic character, and importance of the following heterocycles: Triazoles, Oxadiazoles, Thiadiazols, Triazines. Larger ring and other heterocycles: Synthesis and reactivity of Azepines, Oxepines and Thiepines. Synthesis and rearrangement of Diazepines. Synthesis of Benzazepines, Benzodiazepines, Benzoxepines, Benzothiepines, Azocines, and Azonines. Benzannulated azoles and dipolar structures: Benzannulated azoles: Synthesis and reactivity of Benzimidazoles, Benzoxazoles and Benzothiazoles. Heterocycles with Ring-Junction nitrogen: Synthesis and reactivity of Quinolizines, Indolizines and Imidazopyridines. Heterocycles with dipolar structures. Betaines: Formation, aromaticity, and reactivity of pyridine-N-oxides and pyridinium imides. Mesoionic heterocycles: Synthesis and aromaticity of sydnones and 1,3- dipolar addition reaction of mesoionic heterocycles.

**Experiments:**

| | |
|---|---|
| 1 | Synthesis of Thiepine |
| 2 | Synthesis of benzophenone |
| 3 | Synthesis of diazotized compounds (Triazoles) |
| 4 | Synthesis of1,2,4- Triazole |
| 5 | Synthesis of Isoxazole |
| 6 | Synthesis of Ergotamine (Indole based alkaloid) |
| 7 | Synthesis of Cinchonine |
| 8 | Synthesis of Quinine |
| 9 | Synthesis of Prima Quinine |
| 10 | Synthesis of Acetazolamide |

**TEXTBOOKS:**


1) Heterocyclic Chemistry by T.Gilchrist
2) An introduction to the Chemistry of heterocyclic compounds by R.M.Acheson
3) Heterocyclic Chemistry by J.A.Joule&K.Mills
4) Principles of Modern Heterocyclie Chemistry by A.Paquette
5) Heterocyclic Chemistry by J,A.Joule& Smith
6) Handbook of Heterocyclic Chemistry by A.R.Katritzky
7) Aromatic character and aromaticity by G.M.Badger
8) Non-benzenoid aromatic compounds by D.Ginsberg
9) Non benzenoid compounds by Lloy


## PROFESSIONAL ELECTIVES

## 20CY5304: SEPARATION TECHNIQUES

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Describe the theory and principles of chromatographic separation. | PO1, PO5 | 3 |
| CO2 | Discuss principle of paper chromatography, different techniques, and its modification to thin layer chromatography for analytical applications | PO1, PO5 | 3 |
| CO3 | Describe the ION exchange & ION chromatography | PO1, PO5 | 3 |
| CO4 | Explain the Liquid-Liquid chromatographic techniques, instrumentation, and Applications. | PO1, PO5 | 3 |

**Syllabus:**

**Chromatography:** classification of different chromatographic methods, methods of development-Elution development, Gradient elution development, displacement development, and frontal analysis. Principles of chromatography, different migration, adsorption phenomena, partition, adsorption coefficient, retardation factor, retention time and volume, column capacity, temperature effects, partition isotherm. Dynamics of chromatography-efficiency of chromatographic column, zone spreading, High Equivalent Theoretical Plate (HETP), Van Deempter equation, resolution, choice of column, length and flow velocity, qualitative and quantitative analysis. **Column chromatography (adsorption chromatography):** principles, general aspects, adsorption isotherms, chromatographic media, nature of forces between adsorbent and solutes, eluents (mobile phase), column chromatography without detectors and liquid chromatography with detectors and applications. **Paper chromatography:** principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, multiple development, two-dimensional development, reverse phase paper chromatographic technique-visualization and evaluation of chromatograms, applications. **Thin layer chromatography:** principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromate plate, types of development, visualization methods, documentation, applications in the separation, HPTLC-principle, technique, applications. **Capillary Electrophoresis:** Principle, Details of the Instrument, Applications to Inorganic and Organic compounds. **Ion Exchange:** principles of ion-exchange systems, synthetic ion-exchange resins, properties of anion and cation exchange resins, ion-exchange mechanism, ion-exchange equilibria, selectivity, ion-exchange capacity, applications of ion-exchangers in different fields. **Ion exchange chromatography:** Principle, Equipment, Application Specifically Separations of Lanthanides, Actinides, amino acids. **Ion chromatography:** principles of separation, instrumentation, detectors, separation of cations and anions, applications in the analysis of water and air pollutants. **Solvent Extraction:** principles and processes of solvent extraction, Distribution Law and Partition coefficient, nature of partition forces, different types of solvent extraction systems Batch extraction, Continuous extraction, Counter current extraction, solvent extraction systems, applications in metallurgy, general applications in analysis and pre-concentration, special extraction systems like crown ethers, super fluid, and surfactant extractions-examples. **Gel Exclusion chromatography or Gel filtration chromatography:** principles, properties of xerogels, apparatus and detectors, resolution of gel type, applications to organic compounds.

**TEXTBOOKS:**


1. Techniques and practice of Chromatography by R.P.W Scott, Marel Dekker Inc., New York
2. Separation methods by M.N. Sastry, Himalaya Publishing Company, Mumbai


**REFERENCE BOOKS:**


1. Chromatography by E. Helfman, Van Nostrand and Reinhold, New York
2. Chromatography by E. Lederer and M. Lederer, Elsevier, Amsterdam.
3. Chemical separation methods by John A Dean, Von Nostrand Reinhold, New York
4. Techniques and practice of Chromatography by R.P.W Scott, Marel Dekker Inc., New York
5. Basic Gas Chromatography by H.M Mc Nair and J. M. Miller, John Wiley, New York
6. Analytical Gas Chromatography by W. Jeumings, Academic Press, New York
7. Practice of HPLC by H. Eugelhardt (ed), Springer Verrag, Berrin

**20CY5305-APPLICATIONS OF CHEMICAL SPECTROSCOPY**

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Discuss the fundamental principles of basic characterization techniques. | PO-1,4 | 3 |
| CO2 | Apply NMR techniques in the elucidation of complex molecules | PSO-1,2 | 3 |
| CO3 | Determination of elemental or isotopic signature of sample | PO-2,3 | 3 |
| CO4 | Identification of chemical structure of a molecule by spectroscopy | PO-3,4,5 | 3 |

**Syllabus:**

Infrared Spectroscopy: Fourier Transform infrared spectroscopy: Applications. Ultraviolet and visible spectroscopy: Applications of UV-Visible spectroscopy, Nuclear Magnetic Resonance Spectroscopy: Applications of AB, AX, ABC, AMX Systems; double resonance, Lanthanide shift reagents; Carbon-13 NMR spectroscopy; COSY, NOE, FT NMR, 2D NMR and CIDNP. Mass Spectrometry: Fragmentation: McLafferty rearrangement. Particle bombardment methods, PD, SIMS, FAB, Gas chromatography-mass spectrometry, MS data system. Combined Applications: UV, IR, NMR and Mass in the elucidation of molecular structure.

**TEXTBOOKS:**


1) Introduction to Spectroscopy by Donald L. Pavia and Gary M Lanyman, 3rd Edition, Thompson Publishers, 2008.
2) Spectroscopy of Organic Compounds by P.S. Kalsi, 6th Edition, New Age International Publishers, 2004.
3) Elementary Organic Spectroscopy-Principles and Applications by Y. R. Sharma, 5th Edition, S. Chand Publishers, 2007.


**20CY5306- BIO ANALYTICAL CHEMISTRY**

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the basic principles of bioanalysis | PO-2,4 | 3 |
| CO2 | Explain the basic concept of Radiochemical Manometric and Calorimetric | PO-1,3 | 3 |
| CO3 | Apply electrophoretic method in bioassay | PO-2,3 | 3 |
| CO4 | Explain and apply biosensors in biomolecule analysis | PO-2,3,5 | 3 |

**Syllabus:**

Relevance of Bio Assaying and Biochemical Analysis; Spectroscopic methods and fluorometric methods; Quantitation of Enzymes and Optical Methods of Detection of Enzymes; Electroanalytical Methods of Enzyme Detection. Radiochemical, Manometric, Calorimetric and Other Miscellaneous Methods; Immobilization Methods; Methods; Mass Spectrometry of Biomolecules, Matrix-assisted laser desorption/ionization (MALDI). Chromatography of macromolecular biomolecules; Mass Transfer Methods; Centrifugation and Sedimentation Methods; Electrophoretic Methods. Electrochemical Sensors and Bio Sensors in Bioanalysis; Immunoassaying.

**TEXTBOOKS:**


1) Bio Analytical Chemistry by Susan R. Mikkelsen and Eduardo Cortón, John Wiley & Sons Inc, 2004
2) Bio Analytical Chemistry by Andreas Manz and Nicole Pamme, Imperial College Press, 2012


**20CY5307-ENVIRONMENTAL CHEMISTRY**

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand greenhouse effect concept | PO-2,5 | 3 |
| CO2 | Employ various sampling techniques for air sampling | PO-2,3,5 | 3 |
| CO3 | Understand various pollution monitoring techniques | PO-1,3,4 | 3 |
| CO4 | Explain environmental Impact Assessment process | PO-1,2,5 | 3 |

**Syllabus:**

Chemistry of Atmosphere: Composition and structure of atmosphere, Greenhouse effect, Ozone depletion, Photochemical smog, Air sampling techniques, Sources, effects, and monitoring of air pollutants by Instrumental methods. Control of air pollution, Water Pollution, Different types of water pollutants, Sources, characteristics and effects of water pollutants, Monitoring of Water Pollutants. Treatment of Municipal Wastewater, Treatment of Industrial Wastewater, Environmental Impact Assessment process in India. Basic principles of Green Chemistry.

**TEXTBOOKS:**


1) Fundamental Concepts of Environmental Chemistry by G.S. Sodhi, 2nd Edition, Narosa publishing House, 2005
2) New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai, Anamaya publishers, 2004.


## 20CY5308-SURFACE ANALYTICAL TECHNIQUES

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the basic principles of Electron Spectroscopy for Chemical Analysis | PO-1,2 | 3 |
| CO2 | Employ Surface enhanced Raman Spectroscopy (SERS) in mapping and imaging | PO-2,3,6 | 3 |
| CO3 | Describe Electron Energy Loss Spectroscopy | PO-1,2 | 3 |
| CO4 | Apply Low Energy Ion Scattering Spectroscopy for Surface structural analysis | PO-1, 4,5 | 3 |

**Syllabus:**

Electron Spectroscopy for Chemical Analysis (ESCA): Principles, Instrumentation, and Analytical Applications. Auger electron spectroscopy: Principles, Instrumentation, Applications. Secondary ion mass spectrometry (SIMS): Principles, Instrumentation, Applications. Surface enhanced Raman Spectroscopy (SERS): Principles, Instrumentation, Nanoparticulate SERS substrates, Surface enhanced resonance Raman scattering (SERRS), SERRS of Ag and Au metal colloids, Thin solid films, Langmuir-Blodgett Monolayers, SERRS, Mapping and imaging, Applications. Electron Energy Loss Spectroscopy (EELS): Principles, Instrumentation, Applications. Electron Microprobe analysis: Principles, Instrumentation, Analysis of semiconductors and crystalline materials, Applications. Low Energy Ion Scattering Spectroscopy: Principle, Instrumentation, Surface structural analysis

**TEXTBOOKS:**


1) Surface Analysis Methods in Materials Science by D J O'Connor, Brett A Sexton, Roger S C Smart (Eds), 2nd Edition, Springer, 2010.
2) Surface Analysis: The Principal Techniques by John C Vickerman, Ian Gilmore (Eds.), 2nd Edition, Wiley, 2009.
3) An Introduction to Surface Analysis by John F Watts and John Wolstenholme, 2nd Edition, Wiley VCH, 2011.


## 20CY5309-ANALYSIS OF FOOD AND DRUGS

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the importance of food analysis | PO-1,2 | 3 |
| CO2 | Determination of various nutrients in food samples | PO-1, 3,6 | 3 |
| CO3 | Identification of food adulterants | PO-1,2,4 | 3 |
| CO4 | Employ quantitative methods of analysis in drugs in biological fluids | PO-1,5,6 | 3 |

**Syllabus:**

**Food Analysis:** Importance of food analysis, food adulterants, Analysis of Chemical Additives in foods : Division of colour additives, Chromatographic identification of colors, and quantitative estimation of added dyes in foods (Titanium Trichloride Method) **Carbohydrates:** Definition, classification, and functions, Analysis of carbohydrates from food sample by different method i) volumetric determination by Fehling's solution, ii) Colorimetric analysis of carbohydrates by Folin Wu method, Nelson Somyogi method, iii) total carbohydrates by Anthrone method. **Proteins:** Definitions and functions, Analysis of proteins by Kjedahl's method, analysis of protein by Lowry method, Estimation of amino acids by colorimetric method, Estimation of food grain for methionine content. **Determination of food preservatives:** Definition, SO2 legislation and determination by Tanner's method, Nitrate and nitrites legislation and determination, boric acid legislation and determination, Benzoic acid legislation and determination, 4-hydroxybenzoate legislation and determination, ascorbic acid legislation and determination, Analysis of Butylated Hydroxy Toluene (BHT) (Spectrophotometry). **Analysis of Lipids:** Estimation of oil in oilseeds, Estimation of free fatty acids, Saponification value of oils, iodine value, Determination of acid value of oil, determination of peroxide value of oil, Identification, and quantification of fatty acids. **Analysis of milk and milk products:** Composition of milk, analysis of milk with respect to pH, acidity, fates, casein content, lactose content, mineral content, adulteration of milk. **Analysis of drugs:** General idea of the properties of drugs for their characterization and quantification. Qualitative and quantitative estimation of pharmaceutical drugs (Antibiotics, anticancer etc.) in biological fluids using spectroscopic and electrochemical methods. Aspirin, paracetamol, and codeine in APC tablets (NMR), Phenobarbitone in tablets (IR), pivolic acid in dipivefrin eye drops (GC), Assay of hydrocortisone cream. (HPLC). Impurity profiling of Propranolol (GC-MS), famotidine (LC-MS).

**TEXTBOOKS:**


1) Food Analysis, Food Science Texts Series by S Suzanne Nielsen, 3rd Edition, Springer, 2003.
2) Pharmaceutical Analysis by D Lee and M Webb, 1st Edition, Blackwell, 2003.
3) Forensic pharmacy by B.S Kuchekar, and A.M Khadatare Nirali Prakshan)
4) Shreves' Chemical Process Industries fifth edition by George Austin Mg Graw Hill
5) Practical Pharmceutical Chemistry by Becket
6) Basic Analytical Toxicology Published by WHO, By R. J. Flanagan, R. A. Braithwaite, S. S. BrownAvailable Online
7) Biochemical Methods, Third Edition, By S Sadashivan, A.Manickam; NEW AGE International (P) limited, PIBLICATION
8) Pearson's chemical analysis of food


**20CY5313-PHOTO CHEMISTRY AND PERICYCLIC REACTIONS**

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Ability to apply nucleophilic / electrophilic pathway to synthesize new organic entities | PO-2,3 | 3 |
| CO2 | Apply aromatic nucleophilic and free radical substitution mechanisms in new chain linkages | PO-1,3 | 3 |

| | | | |
|---|---|---|---|
| CO3 | Understand organic reaction mechanism in terms of pericyclic reactions at different conditions. | PO-3,4 | 3 |
| CO4 | Ability to explain pericyclic reactions involved in various organic rearrangement reactions. | PO-1,5,6 | 3 |

**Syllabus:**

Organic Photo chemistry: Photo chemical energy plank Condon Principle, Jablonski diagram singlet and triplet states, dissipation of photochemical energy, photosensitization, quenching, quantum efficiency and quantum yield, experimental methods of photochemistry. Photochemistry of carbonyl compounds n- n∗π=π ,π– transitions Norrish type I and Norrish type II cleavages, patterno-Buchi reaction. Photo reduction photochemistry of enone - Hydrogen abstraction, rearrangement of $\alpha$ ; ß -unsaturated ketones and cyclo hexadiene's, Photochemistry of p- Benzoquinones, photochemistry of unsaturated systems - Olefins, cis trans Isomerization and dimerization hydrogen abstractions and, addition acetylenes dimerization, dienes - Photochemistry of 1,3 butadienes (2+2) additions leading to cage structures photochemistry of cyclo hexadienes. Photochemistry of aromatic compounds - Excited state of benzene its 1,2-1,3 1-4 additions, photo Fries rearrangements, photofries reactions of anilides, photo substitution reactions of bermene derivatives. Photochemistry of pyridinium yields, pyrolysis of nitrites esters and barton reaction. Molecular orbital symmetry, frontier orbitals of ethylene, 1,3 Butadiene, 1,3,5- Hexatriene, allyl system, classification of pericyclic reactions FMO approach, Woodward- Hoffman correlation diagram method and perturbation of molecular (PMO) approach for the explanation of pericyclic reactions under thermal and photochemical conditions. Electrocyclic Reactions: Conrotatory and disotatory motions (4n) and (4n+2), allyl systems and secondary effects. Cycloadditions: Antarafacial and suprafacial additions, notation. of cycloadditions, (4n) and(4n+2) systems with a greater emphasis on (2+2) and (4+4) - cycloadditions, (2+2) – additions of ketones secondary effects of substitutes on the rates of cycloadditions and chelotropic reactions. FMO approach and perturbation of molecular (PMO) approach for the explanation of sigma tropic rearrangements under thermal and photochemical conditions. suprafacial and antarafacial shifts of H Sigma tropic shift involving carbon moieties, retention, and inversion of configurations, (3.3) and (5.5) sigma tropic rearrangements detailed treatment of Claisen and Cope rearrangements fluxional tautomerism, aza-Cope rearrangements and Barton reaction

**TEXTBOOKS:**


1) Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, Mc.Graw Hill and Kogakush.
2) Molecular reactions and Photochemistry by Charles Dupey and O. Chapman, Prentice Hall.
3) Pericyclic reactions by S.N. Mukharji, Mcmilan.
4) The modern structural theory in Organic Chemistry by L.N.Ferguson, Pretice Hall
5) Physical Organic Chemistry by Jack Hine, Mc. Graw Hill
6) Mechanisms and Theory in Organic Chemistry by T.H. Lowery and K.S. Rich gardson.


## 20CY5314-ORGANOMETALLIC CHEMISTRY

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Explain the alkyls and aryls of transition metals. | PO-2,3 | 3 |
| CO2 | Describe the transition metal Π-Complexes. | PSO-1,2 | 3 |
| CO3 | Discuss the Homogeneous catalysis | PO-1,2,3 | 3 |
| CO4 | Demonstrate the fluxional organo metallic compounds. | PO-1,2,5 | 3 |

**Syllabus:**

**Organometallic compounds (OMCs):** Classification, Types, Synthetic routes, and stability-Metal alkyl-metal aryl complexes, Metal-Carbon Multiple Bonds: Metal carbenes-Alkylidenes, and metal carbines-alkylidynes; low

valent carbenes and carbynes-synthesis, nature of bond structural characteristics. **OMCs (Transition Metal Π-Complexes):** TMCs with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes-preparations, properties, nature of bonding and structural features. Important reactions in organic synthesis relating to nucleophilic and electrophilic attack on ligands. **Catalysis:** Stoichiometric reactions – Homogeneous: Catalytic Hydrogenation and olefin oxidation, Heterogenous: Metathesis, C-H bond activation, Ziegler-Natta polymerization of olefins, catalytic reactions involving CO such as hydro carbonylation of olefins (oxo reaction), oxo palladation reactions. **Applications of Organometallic Reagents** (OMRs) as catalysts for C-C and C-N: Grignard reagents, Organo-Cu, Zn, Li reagents etc., Carbon-carbon bond formation through coupling reactions - Heck, Suzuki, Stile and Sonogoshira, Oxidative addition, reductive elimination, Migratory insertion reactions, Ligand substitution reactions. **Fluxionality** and dynamic equilibria in OMCs such as n2-olefin, n3-allyl and dienyl complexes.

**TEXTBOOKS:**


1) Advanced Organic Chemistry by F.A. Carey and R.J Sundberg, Plenum.
2) Structure and Mechanism in Organic Chemistry by C.K.Inglod, Cornell University Press.
3) Organic Chemistry by R.T Morrison and R.N. Boyd, Prentice - Hall.
4) Modern Organic Reactions by H.O. House, Benjamin.


## 20CY5315 -BIO ORGANIC CHEMISTRY

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Recognize the structure and function of Carbohydrates, Lipids, Amino acids, proteins, nucleotides, and nucleic acids. | PO-1,2 | 3 |
| CO2 | Understand the reactions of the major catabolic and anabolic pathways of carbohydrates, Lipids, Amino acids, metabolism. | PO-1,3 | 3 |
| CO3 | Understand the signaling pathways of Lipids and Amino acids. | PO-2,3 | 3 |
| CO4 | Demonstrate the chemistry and kinetics of enzymes. | PO-1,5,6 | 3 |

**Syllabus:**

Amino acids, peptides, and proteins Amino acids: acid base properties, isoelectric point, separation, resolution of racemic mixtures of amino acids, asymmetric synthesis Peptide bonds: peptide secondary structures and their stabilization, strategies for peptide synthesis, automated peptide synthesis. Primary, secondary, tertiary and quaternary structures, protein denaturation, natural β-amino acids and β-peptides; β-turn peptidomimetics, β-lactam based peptidomimetics. Enzymes Classification of enzymes, enzyme catalysis and kinetics, nucleophilic acid, base and metal-ion catalysis, the catalytic triad, mechanisms of carboxypeptidase A, serine proteases and lysozyme, enzyme inhibition and drug design. Nucleosides and nucleotides, conformation of sugar-phosphate backbone, hydrogen bonding by bases, the double helix, A, B, and Z double helices.

**TEXTBOOKS:**


1. Organic Chemistry by P. Y. Bruice, 5th Ed., Pearson, 2014.
2) Introduction to Bioorganic Chemistry and Chemical Biology by D.V. Vranken and G.A. Weiss, 1st Ed., Garland Science, 2012.
3) Essentials of Carbohydrate Chemistry and Biochemistry by T. K. Lindhorst, 3rd Ed., Wiley 2007.
4) Peptides: Chemistry and Biology by N. Sewald and H.D Jakubke, 2nd Ed. Wiley, 2009.


## 20CY5316-GREEN & SUSTAINABLE CHEMISTRY

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Explain basic principles of green and sustainable chemistry. | PO-2,4 | 3 |
| CO2 | Understand the Stoichiometric calculations and relate them to green process metrics. | PO-1,3,4 | 3 |
| CO3 | Review the principles of catalysis, photochemistry and other interesting processes from the viewpoint of Green Chemistry. | PO-3,6 | 3 |
| CO4 | Apply alternative solvent media and energy sources for chemical processes. | PO-2,3,5 | 3 |

**Syllabus:**

Principles of Green Chemistry, Concept of atom economy, Tools of Green Chemistry: Alternative feedstocks/starting materials, Reagents, Solvents, Product/target molecules, Catalysis, and process analytical chemistry. Evaluation of chemical product or process for its effect on human health and environment. Evaluation of reaction types and methods to design safer chemicals. Evaluating the effects of Chemistry: Toxicity to humans, Toxicity to wildlife, Effects on local environment, Global environmental effects. Planning a green synthesis. Applications of Green Chemistry: Green synthesis of Ibuprofen, Design and application of surfactants for carbon dioxide for precision cleaning in manufacturing and service industries, Polyester regeneration technology, Microbes as environmentally benign synthetic catalysts, environmentally safe marine antifoulant. Biodegradable poly aspartate polymers for inhibitors and dispersing agents, Recent applications in green chemistry.

**TEXTBOOKS:**

1) Introduction to Industrial Chemistry by Howard, W.L., Wiley-Interscience.
2) Industrial Organic Chemistry by Weissermel, K., and Arpe, H.J., 3rd ed.
3) Green Chemistry and Catalysis by Sheldon, R.A., Arends, I., and Hannefed, U., Wiley-VCH Verlag GmbH and Co.
4) Green Chemistry Frontiers in Benign Chemical Synthesis and Processes by Anastas, P., and Williamson, T. C., Oxford University Press.
5) New Trends in Green Chemistry by Ahluwalia, V. K., and Kidwai, M., Anamaya Publishers

## 20CY5317-SUPRAMOLECULAR CHEMISTRY

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Explain concepts, properties, and reactions of supra molecular chemistry. | PO-2,3 | 3 |
| CO2 | Cation-binding hosts and binding of anions and neutral molecules. | PO-1,4 | 3 |
| CO3 | Apply the supra molecular chemistry in biology | PO-2,4 | 3 |
| CO4 | Apply the supra molecular chemistry in Chemistry | PO-1,2,5 | 3 |

**Syllabus:**

***Concepts of Supramolecular Chemistry:*** Definition: From molecular to Supramolecular**.** Nature of supramolecular interactions (hydrogen bonding, metal coordination, hydrophobic forces, van der Waals forces, pi–pi interactions and electrostatic effects). Host-guest interaction. Molecular recognition. Types of recognition. Self-assembly in biological systems (including DNA and enzymes) ***Cation-binding Hosts:*** Concepts: Macrocyclic and template effects. Cation receptors: Crown ethers, Cryptands, Spherands, Calixarens. Selectivity of cation complexation. ***Binding of Anions and Neutral molecules:*** Concepts, Anion host design, Anion receptors. Shape and selectivity, Neutral receptors, clathrates, cavitands, cyclodextrins, cyclophanes. ***Applications of Supramolecular Chemistry in Biology:*** Biological mimics, Metalloproteins, Membrane transport, Ionophores, Heme analogues, Photosynthesis, Oxygen transport, Metalloenzymes ***Other applications of Supramolecular Chemistry:*** Supramolecular reactivity and catalysis, Supramolecular devices and sensors, Nanoscience applications, Drug delivery and sensing.

**TEXTBOOKS:**

1) Advanced Textbook on Food and Nutrition by Swaminathan M. Volume I and II Printing and Publishing CO., Ltd., Bangalore. 1993.
2) Textbook on Food Chemistry by Swaminathan M. Printing and Publishing CO., Ltd., Bangalore. 1993.
3) Food science by Norman N. Potter, CBS publishers and distributors New Delhi. 1994.
4) Food Chemistry by Lillian Hoagol and Meyer CBS publishers and distributors, New Delhi, 1994.

**20CY5318-MEDICINAL CHEMISTRY**

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | To understand the drug metabolic pathways adverse effects and the therapeutic value of drugs. | PO-2,4 | 3 |
| CO2 | To know the structure activity relationship of the different class of drugs. | PO-1,3 | 3 |
| CO3 | To describe the mechanisms pathways of different class of medicinal compounds. | PO-1,2 | 3 |
| CO4 | To understand the chemistry of drugs with respect to their pharmacological activity | PO-1,2,3 | 3 |

**Syllabus:**

Classification and Nomenclature of Drugs. Medicinal chemistry: Important terminology in medicinal chemistry. Classification and Nomenclature of Drugs. Concept of prodrugs and soft drugs. a) Prodrugs: i) Prodrugs designing, types of prodrugs. Prodrug formation of compounds containing various chemical groups, Prodrugs, and drug delivery system b) Soft drugs: i) Soft drug concept ii) Properties of soft drug. Theories of drug activity: i) Occupancy theory, ii) Rate theory, iii) Induced theory. QSAR method: Introduction, Methods used in QSAR studies, Hansch method, Free-Wilson method, Advantages and disadvantages of free approach, Computer based methods of QSAR related to receptor binding, Physico-Chemical properties, Lipophilicity, Electronic parameters, Steric substituent constants, Experimental determination of partition coefficients. Structure based drug design: i) Process of structure-based drug design, ii) Deactivation of certain drug, iii) Determination of the structure of the protein, iv) Design of inhibitors. Molecular modelling using computers. i) Introduction ii) Uses of molecular modeling: a) Manual use, b) Further-computer programming, c) X-ray crystallography. Pharmacokinetics and Pharmacodynamics. A] Pharmacokinetics: a) Drug absorption, b) Distribution, c)Elimination, d) Disposition. B] Pharmacodynamics. a) Introduction, Elementary treatment of enzyme inhibition, b) Membrane active drug, c) Sulphonamides Mechanism of action of following drugs: Action of CNS disorder, inflammation, cardiac dysfunction. MC-4: Drug metabolism.

**TEXTBOOKS:**

1. Burger's Medicinal Chemistry and Drug Discovery by M.E. Wolf, Vol. I, John Wiley.
2. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.

**20CY5403 – DISSERTATION WITH RESEARCH PUBLICATION**

**L-T-P-S: 0-0-12-0** **Credits: 6** **Prerequisite: NIL**

**20CY5404- CHROMATOGRAPHIC TECHNIQUES & METHOD VALIDATION**

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Discuss about the GC & GC-MS Techniques and its applications | PO-1,3,4 | 3 |
| CO2 | Discuss the Liquid-Liquid partition chromatography and HPLC techniques and their applications | PO-1,3 | 3 |
| CO3 | Apply LC-MS and inorganic molecular sieves for various purposes. | PO-3,5 | 3 |

| | | | |
|---|---|---|---|
| CO4 | Develop analytical methods to solve industrial problems and solvent extraction as significant analytical method of purification and separation. | PO-2,3,6 | 3 |

**Syllabus:**

**Gas chromatography:** Theory, Instrument description of equipment and different parts, columns (packed and capillary columns), detector specifications-thermal conductivity detector, flame ionization detector, electron capture detector, nitrogen-phosphorus detector, photo ionization detector, programmed temperature gas chromatography; applications in the analysis of gases, petroleum products etc., other detectors used their Principles and Applications. **GC-MS-Introduction:** Instrumentation – GC – MS interface – Mass spectrometer (MS) Instrument operation, processing GC – MS data – ion chromatogram Library searching – Quantitative measurement-sample preparation Selected ion monitoring – Application of GC-MS for Trace constituents, Drugs analysis, Environmental analysis, and others. **Liquid-liquid partition chromatography:** Principle supports, partitioning liquids, eluents, reverse phase chromatography, apparatus, and applications. **High performance liquid chromatography:** Theory, Instrument description of the different parts of the equipment, columns, detectors-UV detector, refractometric detector, Fluorescence detector, Diode Array detector, applications in the separation of organic compounds, names of other detectors used their Principles and Applications. **LC-MS:** Introduction-Instrumentation-liquid chromatograph-Mass spectrometer Interface Instrumental Details-Processing LC-MS data-ion chromatograms-Library Searching-Quantitative measurements. Sample preparation – selected ion monitoring. Application of LC-MS for Drug analysis, Environmental samples, and others. **Inorganic molecular sieves:** structure of zeolites, crystals, types of sieves, application in the separation of gases including hydrocarbons, ion exclusion-principles and applications, Counter current chromatography-principles and application, Affinity chromatography-principles and applications. **Analytical Method Developments and validation:** Importance of Qualitative and Quantitative analysis in research and development, industries, and other branches of science. Development and validation of an analytical method, units, concentrations, calculations, standards, chemical reactions, expressions of concentrations. Introduction, Dissolution test, Apparatus –USP type –I and II, Sampling and analytical instrumentation, Single point test Vs. Dissolution profile, Calibration, regulatory guidelines, analytical validation, linearity, accuracy, precision, specificity. Limit of quantification, sensitivity, ruggedness and robustness, analyte stability in the sample matrix, how to reduce systematic errors, mean and standard deviation, reliability of results, confidence interval, comparison of results, comparison of two means of two samples, experimental design. Sampling of solids, liquids and gases

**TEXTBOOKS:**


1) Techniques and practice of Chromatography by R.P.W Scott, Marel Dekker Inc., New York.
2) Separation methods by M.N Sastri, Himalaya Publishing Company, Mumbai.


**REFERENCE BOOKS:**


1) Chromatography by E. Helfman, Van Nostrand, Reinhold, New York
2) Chromatography by E. Lederer and M. Lederer, Elsevier, Amsterdam.
3) Chemical separation methods by John A Dean, Von Nostrand Reinhold, New York.
4) Techniques and practice of Chromatography by R.P.W Scott, Marel Dekker Inc., New York.
5) Thin layer chromatography by E.Stahl, Academic Press, New York


## 20CY5405- CLASSICAL METHODS OF ANALYSIS-II

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the principles of Quality control in Analytical Chemistry | PO-2,4 | 3 |
| CO2 | Explain the various concepts of decomposition techniques in analysis | PO-2,3 | 3 |
| CO3 | Illustrate, discuss, and apply the various principles behind the various Red-ox systems involved in the classical Volumetric methods of analysis. | PO-1,3,5 | 3 |
| CO4 | Explain the various principles involved in the analysis of Organic | PO-1, 4,5 | 3 |

| | | | |
|---|---|---|---|
| | Functional Groups | | |

**Syllabus:**

**Precipitation methods-I** Crystal habit and super saturation, nucleation and crystal growth, homogeneous and heterogeneous nucleation, solubility and particle size, colloids, completeness of precipitation, effect of excess precipitant, pH, complex formation, temperature, purity of precipitates, aging. **Co-precipitation and post precipitation:** theory of adsorption of salts having an ion in common with the main precipitate, co-precipitation in colloidal precipitates, adsorption of solvents, mixed crystal formation by occlusion and entrapment, re-precipitation with examples, post-precipitation – theory of post-precipitation, examples of post-precipitation, conditions for obtaining pure and quantitative precipitates. **Precipitation Titrations**: Principle, Indicators for precipitation titrations, determination of halides. **Precipitation methods-II Precipitation from Homogeneous Solution (PFHS):** theory of PFHS, methods of PFHS – increase in pH, decrease in pH, cation release, anion release, reagent synthesis, change in oxidation state, photochemical reactions, precipitation from mixed solvents Applications of PFHS methods. **Gravimetric determinations:** nature of species, preparation of solutions, limitations, interferences, inorganic precipitants-chloride and sulphate, organic precipitants dimethyl glyoxime (DMG), oxine, benzidine, salicyl aldoxime, benzoin oxime, sodium tetraphenyl boron, tetraphenyl arsonium chloride. **Electro-gravimetric analysis:** principle, important terms in electrogravimetry, decomposition voltage or decomposition potential, over voltage and their importance, instrumentation, electrolysis at constant current, determination of $Cu^{2+}$ by constant current electrolysis, electrolysis at controlled potentials, determination of Cu, Pb, Sn in brass and bronze by controlled potential electrolysis. **Reductant system – Principles and applications in analysis:** Analytical chemistry of some selected reductant systems – formal, standard, and normal potentials in various media, stability of the solutions, species responsible for the reduction properties, standardization, requirement for the selection of the reductants, selection of suitable indicators for various reductant systems: Inorganic Systems – Cr (II), V (II), Ti (III), Sn (II), Fe (II) in $H_3PO_4$ and hydrazine. Organic Systems: hydroquinone and Ascorbic acid. **Analysis of some selected Drugs:** Basic considerations of drugs – Classification **Determination** of the following Drugs: Acetyl salicylic acid (Antipyretic–Analgesic)**,** Testosterone, progesterone, and cortisone (Steroids and corticoids)**,** Sulphadiazine (sulphadrugs)**,** Phenobarbitone (Barbituric acid derivatives)**,** Chloramphenicol, Benzyl penicillin and Tetracycline (Antibiotics). Determination of Thiamine (B1), Riboflavin (B2) and ascorbic acid (c) [Vitamins] Isoniazid (Anti micro bacterial agents)**,** Methyldopa (Antihypertensive agents) Metronidazole (Anti amoebic agents).

**TEXTBOOKS:**


1) Technical methods of analysis by Griffin, Mc Graw Hill Book Co.
2) **C**hemical Separation and measurements by D.G Peterseti, John M.Haves Sanders Co.
3) Chemical analysis by H.A Laitinan, Mc Graw Hill Book Co.
4) Newer redox titrants by Berka, Zyka and Vulterin, Pergamon Press
5) Volumetric Analysis, Vol III by I.M Kolthoff and R.Belvher, Interscience Public, New York
6) Vogel's Text Book of Inorganic Quantitative Analysis by J.Bassett et al, ELBS
7) Pharmaceutical analysis by T. Higuchi, Brochmann hausfen


**REFERENCE BOOKS:**


1) Analytical Chemistry, An Introduction, D.A Skoog, D.M West and F.J Holler, Sanders College Publishing, New York.
2) Quantitative Chemical Analysis by I.M Kolthoff, E.B Sandel, E.J Meehan, S. Bruckenstein, Macmillan Company, London


## 20CY5406- CHEMO SENSORS AND BODY FLUID ANALYSIS

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the principles of various chemical sensors | PO-2,3 | 3 |
| CO2 | Analysis of biomolecules in body fluids | PO-1,2,3 | 3 |

| | | | |
|---|---|---|---|
| CO3 | Employ analytical techniques in the determination of vitamins | PO-2,3,6 | 3 |
| CO4 | Apply Immunoanalytical Techniques in clinical analysis | PO-3,4,5 | 3 |

**Syllabus:**

**Chemical Sensors:** Introduction, definitions, Classification of chemical sensors, descriptions of chemical sensors (electrochemical sensors, potentiometric sensors, voltametric chemical sensors, sensors based on conducting properties), Optical sensors (light guides, the evanescent wave, design of fiber optic sensor, indicator mediated sensor), Calorimetric sensors (catalytic gas sensor, thermal conductivity sensor), mass sensor (piezoelectric quartz crystal resonator, surface acostic wave sensor). **Biosensors in analysis:** Introduction, producing biological surface, Achievement of biotransduction (amperometric, potentiometric, optical). **Collection of Specimens:** Blood: Collection of Blood specimens, storage and preservation, Urine: Collection of Urine, physical characteristics of urea, preservation and storage, Faeces: Collection and preservation. **Analysis of Blood and urine**: Determination of blood and plasma glucose by glucose oxidase method, Determination of urine for glucose, Determination of ketone bodies in blood, Determination of serum creatinin, estimation of serum bilirubin, Estimation of serum cholesterol, determination of blood hemoglobin, Determination of urea in urine by urease method and by direct colorimetry. **Determination of vitamins in body fluid:** Classification of vitamins with example, Each vitamin must be explained with respect of functions, deficiency diseases, daily requirement, and analytical method i) Retinol (determination of retinol and serum carotene in serum using TFA), Vit D3 (Cholecalciferol), Vitamin E (Tocopherols, Determination of serum tocopherol by spectrophotometry by dipyridyl method), Vitamin B1 (thiamine determination by flurometry), Vitamin B2 (riboflavin, Photo fluorometric method), Vitamin B6 (Pyidoxine, Fluorometric determination of Xanthuric acid), Nicotinic acid and Niacin: determination by fluorometry, Ascorbic acid (vitamin –c) Volumetric method using 2,6 dichlorophenol method, colorimetric determination of leucocyte ascorbate. **Immunoanalytical Techniques:** Radioimmunoassay, its principle and applications, instrumentation for radio bioassay, clinical application of the radioimmunoassay of insulin, Estrogen and progesterone, receptor techniques of breast cancer. Enzyme- linked immunosorbent assay (ELISA), Types of ELISA, principles, practical aspects, applications.

**TEXTBOOKS:**


1) Standard methods of chemical analysis by F.J. Welcher, 6th Edition,.
2) Quantitative Inorganic Analysis including Elementary Instrumental analysis by A. I. Vogel, 3rd Edition, ELBS, 1964.
3) Instrumental methods of analysis by R. D. Braun
4) Analytical Chemistry, Ed. by Kellner, Mermet, otto, Valcarcel, Widmer, Second Ed. Wiley –VCH
5) Practical Clinical Biochemistry by Gowenlock, CBS published, 6th Ed.


## 20CY5410-DRUG DESIGN & DEVELOPMENT

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Outline the synthesis and properties of antibiotics. | PO-2,3 | 3 |
| CO2 | Describe the psycho active drugs and their synthesis along with properties. | PO-1,3 | 3 |
| CO3 | Exposed to drug design and its tools | PO-1,2,3 | 3 |
| CO4 | Describe the QSAR Studies | PO-1,2,4,5 | 3 |

**Syllabus:**

Antibiotics: β-lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicllin V, amoxicillin, cephalosporin, tetracycline. Local Anti-infective Drugs Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, ciprofloxacin, norfloxacin, dapsone, amino Salicylic acid, ethionamie, flucanazole, griseofulvin, chloroquin and pramaquin. Psychoactive Drug: Introduction, neurotransmitters, NA

Dopamine, 5HT, acetylcholine, GABA, Histamine, serotonin, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepine, neurochemistry of mental diseases. Antipsychotic drugs-neurolcptics, antidepressants, butyrophenones. Synthesis of diazepam, oxazepam, phenytoin, barbiturates, thiopental sodium, glutethimide. Drug Design: Development of new drugs, procedures followed in drug design, concept of lead compound and lead modification, concepts of prodrugs and softdrugs, structure- activity relationship (SAR). Theories of drug activity: occupancy theory, rate theory, induced theory, Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions. physicochemical parameters: lipophilicity, partition coefficient, electronic ionization constant, steric, Shelton and surface activity parameters and redox potentials. Free-Wilson analysis, Hansch analysis, relationship between Free-Wilson and Hansch analysis. LD-50, ED-50 (mathematical derivation of equations excluded).

**TEXTBOOKS:**


1) The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1, 5th Edition, John Wiley & Sons, 2001.
2) Organic Chemistry by IL Finar, Vol. I and II, 5th Edition, ELBS, 2004.
3) Graham L. Patrik, Drug Design and Development, Elsevier Publisher, 2002.
4) Exploring QSAR: Fundamentals and applications in Chemistry and Biology, Vol-I, by corwin hasch, Albert lio and David Hoekman, ACS Professional Reference books.


## 20CY5411-CHEMISTRY OF DRUGS AND PHARMACEUTICALS

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the medicinal and pharmaceutical importance of the organic compounds. | PO-1,2 | 3 |
| CO2 | Explain the Chemical and Biological assay of the various class of compounds. | PO-1,2 | 3 |
| CO3 | Describe the structure and properties of Vitamins: A, B, C, D, E and K; Hormones: Sex hormones, Steroidal and Non-steroidal hormones, Adrenaline, Thyroxine and Cardiac glycosides etc., | PO-1,4,5 | 3 |
| CO4 | Paraphrase the Pharmacological activity, uses and limitations of Antipyretics, Analgesics, Sedatives, Hypnotics, Barbiturates, Sulphadrugs, Anaesthetics, Antiseptics, Antibacterials, Diuertics, Anthelmentics, Anticoagulants, Anticonvulsants, Antihistamines, Psychotherupeutics. | PO-1,2,3, | 3 |

**Syllabus:**

Chemical and Biological assay of the following compounds: Vitamins: A, B, C, D, E and K; Hormones: Sex hormones, Steroidal and Non-steroidal hormones, Adrenaline, Thyroxine and Cardiac glycosides. Penicillin, Streptomycin, Chloromycetin, Tetracyclins, Novobiocin and Cephalosporins. Pharmalogical activity, uses and limitations of Antipyretics, Analgesics, Sedatives, Hypnotics, Barbiturates, Sulphadrugs, Anaesthetics, Antiseptics, Antibacterials, Diuertics, Anthelmentics. Anticoagulants, Anticonvulsants, Antihistamines, Psychotherupeutics.

**TEXTBOOKS**:


1) The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1, 5th Edition, John Wiley & Sons, 2001.
2) Organic Chemistry by IL Finar, Vol. I and II, 5th Edition, ELBS, 2004.
3) Graham L. Patrik, Drug Design and Development, Elsevier Publisher, 2002.


## 20CY5412 – NANO CHEMISTRY

**L-T-P-S: 3-0-0-0** **Credits: 3** **Prerequisite: NIL**

**Mapping of Course outcomes (CO) with program outcomes (PO) with BTL:**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO1 | Understand the effects of nano dimensions of particles. | PO-1,2 | 3 |
| CO2 | Exemplify links between nano science and biological systems. | PO-1,3 | 3 |
| CO3 | Describe several synthetic methods for the fabrication of nano particles. | PO-1,2,3 | 3 |
| CO4 | Provide perspectives on future nano chemistry developments. | PO-1,4,5 | 3 |

**Syllabus:**

Scope and importance of nanoscience and nanotechnology. Synthetic Methods: Chemical Routes: Physical methods, Techniques for characterization. BET method for surface area analysis. Dynamic light scattering for particle size determination. Synthesis, properties and applications of fullerenes, carbon nanotubes, core-shell nanoparticles, self- assembled monolayers, nanocrystalline materials, magnetic nanoparticles thermoelectric materials. Non-linear optical materials, liquid crystals.

**TEXTBOOKS:**

1) NANO: The Essentials by T. Pradeep, McGraw-Hill, 2007.
2) Textbook of Nanoscience and Nanotechnology by B S Murty, P Shankar, Baldev Rai, B B Rath and James Murday, Univ. Press, 2012.

**PROJECT(SKILL DEVELOPMENT)**

**20CY5403-DISSERTATON WITH RESEARCH PUBLICATION**

**L-T-P-S: 0-0-12-0** **Credits: 6** **Prerequisite: NIL**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO5 | Performing dissertation work and presentation | PO-5,6 | 6 |

**20CY5409-DISSERTATON WITH RESEARCH PUBLICATION**

**L-T-P-S: 0-0-12-0** **Credits: 6** **Prerequisite: NIL**

| CO# | Course Outcome | PO | BTL |
|---|---|---|---|
| CO5 | Performing dissertation work and presentation | PO-5,6 | 6 |