15CHP101    ORGANIC CHEMISTRY- I (REACTION MECHANISMS)   Semester-I

Instruction Hours/week:L: 4 T:0 P:0   Marks: Internal:40 External: 60 Total:100

Scope
The course presents the knowledge about the basics of organic chemistry, involving
aromaticity, principles of various organic reactions and their mechanisms and also
describes the application of reactions.

Objectives
1. To understand aromaticity.
2. To provide a versatile knowledge of different name reactions and their application in
   synthesis.
3. To understand the principles and reaction mechanisms involving various
electrophilic and nucleophilic, addition and elimination reactions.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Aromaticity and chemical methods in mechanisms: Aromaticity - introduction -
aromaticity of benzenoid and heterocyclic compounds. Non-benzenoid aromatics –
annulenes, azulenes, ferrocenes and fulvenes.

Kinetic and non-kinetic methods of study of reaction mechanisms - kinetic methods-
Primary and secondary kinetic isotopic effects. Non-kinetic methods - study of
intermediates, isotopic labeling, stereochemical studies, energy profile diagrams and
cross over experiments. Hammond’s postulate. Kinetic and thermodynamic control.

Linear free energy relationship - Hammett equation and Taft equation.

UNIT – II
Addition reactions: Electrophilic, nucleophilic and free radical addition to double and
triple bonds - hydration, hydroxylation, Michael addition, hydroboration and epoxidation.

Addition reactions to carbonyl compounds – Mannich reaction, Meerwein Pondooff-
Verley reduction, Grignard, Claisen, Dieckmann, Stobbe, Knovenagel, Darzen, Wittig,
Thorpe and Benzoin reactions.

UNIT – III
Electrophilic substitution reactions: Aromatic electrophilic substitution reactions-
formylations–Gattermann, Gattermann Koch and Riemer Tiemann reactions. Kolbes,
Bischler-Napieralski and Hofmann-Martius reactions. Friedel crafts alkylation and
acylations.
Aliphatic electrophilic substitution reactions - mechanisms- SE1, SE2 and SEi - structure reactivity relationship, typical electrophilic substitution reactions - Friedel crafts acylation at olefinic carbon, Stork enamine reaction and decarboxylation of aliphatic acids.

UNIT – IV
Nucleophilic substitution reactions: Aliphatic nucleophilic substitution reactions-mechanisms - SN1, SN2, ion pair and SNi- substitution at vinyl carbon. Stereochemistry of nucleophilic substitution reaction - effect of substrate structure - solvent effects - leaving group effect – nucleophilicity, ambident nucleophiles and ambident substrates-neighbouring group participation.

Aromatic nucleophilic substitution reactions - benzyne mechanism, intermediate complex mechanism and SN1 mechanism, structure reactivity relationship.

Ziegler alkylation and Chichibabin reaction.

UNIT – V

Carbenes and nitrenes - structure, generation and reactions.

TEXT BOOKS:

REFERENCES:
Scope
Nuclear chemistry is the branch of chemistry that deals with the properties and behavior of atomic nuclei. It involves radioactivity and radioactive substances, as well as the equipment and systems that are used to trigger and maintain nuclear processes. Nuclear chemistry also includes the effects of radiation on other matter, both that of living things and non-living matter. Because nuclear chemistry is the study of atomic nuclei, and because all matter is composed of atoms, nuclear chemistry has a wide scope that tackles a variety of topics, and also has various applications.

Metal clusters occupy a central role in chemistry. Aspects of cluster chemistry impinge on branches of the subject ranging from organometallic chemistry, through coordination chemistry, homogeneous and heterogeneous catalysis to solid-state chemistry and catalysis.

Objectives
1. To learn the nuclear structure, stable and unstable atomic nuclei, nuclear reactions and different modes of radioactive decay and also methods for measurements of radioactivity.
2. To understand the detection of radioactive rays and to measure the radiation.
3. To learn about the fundamentals of metallic clusters.
4. To understand the chemistry of boranes and related compounds.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Inorganic chains – rings - cages and clusters (definition and structure) - metal clusters - dinuclear clusters - trinuclear clusters - tetranuclear clusters - hexanuclear clusters – organometallic clusters.

Boranes, boron hydrides (structure and properties) – carboranes - metallocarboranes - Wade’s theory -closo-nido and arachno structures - borazines, phosphazenes – Sulphur-Nitrogen ring compounds. Isopoly and heteropoly acids of V, Cr, Mo and W.

UNIT – II
Metallic state-free electron, band and zone theories - non stoichiometry - point defects in solids - Schottky and Frenkel defects - linear effects - dislocation - effects due to dislocation - electrical properties of solids - insulators-intrinsic semiconductors - n and p type and super conductors - ceramics elementary treatment.

UNIT – III
Nuclear Chemistry - the nucleus - subatomic particles and their properties, binding energy. N/P ratios in stable and meta stable nuclei - different type of nuclear forces - liquid model- shell model. Modes of radioactive decay - α, β and γ decay radiation, electron capture, nuclear isomerism, internal conversion.

UNIT – IV
Experimental methods - Cloud chamber, nuclear emulsion, bubble chamber, proportional counters-G.M counter, scintillation counters, semi conductor detector. Particle accelerators - Cyclotron, synchrotron, betatron and bevatron.

UNIT – V
Nuclear reactions - Bethes’s notation, Q-value, columbic barrier, cross section, different types of nuclear reactions - projectiles capture - particle emission, spallation, fission, fusion, theories of fission, use of fission products, nuclear reactors - fissile and fertile isotopes- U^{233},U^{235},Pu^{239},Th^{232} -atomic power projects in India, stellar energy, synthetic elements - application of radio isotopes - Hot atom chemistry.

TEXT BOOKS:

REFERENCES:
15CHP103 PHYSICAL CHEMISTRY- I
(QUANTUM CHEMISTRY AND GROUP THEORY)

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Scope
This course presents the Basic principles of quantum chemistry which involves the failure
of classical mechanics, wave equations, approximation methods and basic concepts of
Group Theory.

Objectives
1. To study the fundamentals and applications of classical mechanics and quantum
chemistry
2. To understand the structure of an atom and different approximation methods
3. To learn the concept of Group theory and their applications.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Failure of classical mechanics and the success of quantum theory in explaining black
body radiation and photoelectric effect.

The time dependent and time independent Schrodinger equations - Born’s interpretation
of the wave function. Requirements of the acceptable wave function.

Algebra of operators. Sums and products of operators - commutator - linear operators-
eigen functions and eigen values - correspondence between physical quantities in
classical mechanics and operators in quantum mechanics - Hamiltonian operator -
angular momentum operator. Quantization of angular momentum and its spatial
orientation - average values - postulates of quantum mechanics.

UNIT – II
Particle in a one-dimensional box - quantization of energy - normalization of wave
function - orthogonality of the particle in a one-dimensional box wave functions.
Illustration of the uncertainty principle and correspondence principle with reference to
the particle in a one-dimensional box - particle in a three dimensional box - separation of
variables.

Solving of Schrodinger equation for one-dimensional harmonic oscillator. Harmonic
oscillator model of a diatomic molecule. Illustration of the uncertainty principle and
correspondence principle with reference to harmonic oscillator.
Solving of Schrodinger equation for a rigid rotor. Rigid rotor model of a diatomic molecule.

UNIT – III
Schrodinger equation for the H-atom (or H-like species)- separation of variables - energy levels. Radial distribution functions - orbitals and orbital shapes. Probability density and radial distribution functions.

Need for approximation methods. The perturbation theory- application of perturbation method to systems such as anharmonic oscillator and He-atom.

The variation method - application of variation method to systems such as anharmonic oscillator and He-atom.

UNIT – IV
Symmetry elements and symmetry operations - definition of identical and equivalent elements configurations - effect of performing successive operations commutative and non-commutative - inverse operations.

Groups and their basic properties - definition of a group - basic properties of a group-definition of abelian - cyclic- isomorphic, finite, infinite groups and subgroup. Symmetry classification of molecules into point groups-Schoenflies symbol (only-difference between point group and space group).

Matrices- Definition of matrix, square matrix, diagonal matrix, null matrix, unit matrix, row matrix, column matrix, symmetric matrix, skew symmetric matrix and conjugate matrix. Multiplication, commutative and non commutative-determination of inverse of a matrix, block multiplication of matrices-addition and subtraction of matrices.

Matrix notations for symmetry operations of $C_{2v}$ and $C_{3v}$ groups-construction of character tables for $C_{2v}$ and $C_{3v}$ point groups.

UNIT – V
Definition of reducible and irreducible representations - irreducible representations as orthogonal vectors - direct product rule, the great orthogonality theorem and its consequences - determinations of the characters for irreducible representation of $C_{2v}$ and $C_{3v}$ point groups using the orthogonality theorem.

Group theory and Vibrational spectroscopy - vibrational modes as basis for group representation - symmetry selection rules for IR and Raman spectra, Mutual exclusion principle - classification of vibrational modes.

Group theory and dipole moment.
TEXT BOOKS:

REFERENCES:
Scope
Spectroscopic analysis is based on an atom or compound’s interaction with electromagnetic radiation of specific wavelength. Spectroscopy provides information on chemical identity of a compound, quantity present and structure based on the technique selected and the wavelength of electromagnetic spectrum.

Objective
1. To learn about Electronic spectroscopy.
2. To understand about IR spectroscopy.
3. To learn the different aspects of NMR spectroscopy.
4. To learn about the mass spectroscopy and Mossbauer spectroscopy.
5. To learn about the invaluable tools in synthetic chemistry for the confirmation of known molecules and elucidation of shape and structures of unknown compounds of high complexity with a high degree of certainty.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

UNIT-II
Infrared Spectroscopy: The vibrating diatomic molecules-the simple harmonic oscillator and unharmonic oscillator - the diatomic rotor - factors influencing vibrational frequencies - identification of fundamental groups. Fingerprint region-application to organic and inorganic compounds-Instrumentation.

UNIT-III
NMR Spectroscopy: Principle of NMR spectroscopy – description of the PMR instrument, factors affecting chemical shifts-chemical shift equivalence and magnetic equivalence - spin-spin coupling - first order and non first order spectra - Hetero nuclear coupling in ¹H NMR - deuterium exchange - high field spectra - double resonance-shift reagents-applications to organic and inorganic compounds. FT NMR.

¹³C NMR spectroscopy-factors affecting the chemical shifts - broad band and off-resonance decoupling - applications in organic chemistry.
UNIT – IV

UNIT – V

Problems involving UV, IR, NMR, Mass spectral data (for compounds not more than 10 carbon atoms).

TEXT BOOKS:

REFERENCES:
Scope
Green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.” Green chemistry places equal importance on the development of science with the effects the development has on the environment and the global population. Green chemistry breaks away from the traditional methods that solely considered the treatment or abatement of pollution after it was created, and considers alternative routes obviating the need to produce the waste.

The course also deals with the Basics of Medicinal chemistry, Drug targets, Pharmacokinetics and drug metabolism, Clinical training in the medicinal chemistry area.

Objectives
1. To introduce the concept of Green chemistry.
2. To understand the basics of Medicinal chemistry.
3. To introduce the 12 principles of Green chemistry as well as the tools of Green chemistry.
4. To demonstrate how to evaluate a reaction or process and determine “Greener” alternatives.
5. To focus on the application of greener routes to improve industrial processes and to produce important products.
6. To understand the drug targets, drug metabolism and about clinical training.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Introduction to green chemical principles: Definition, twelve principles of green chemistry, solventless reactions - reactions in water, microwaves and fluorous solvents - Atom efficient processes: evaluating chemical reactions according to their yield and atom efficiency - examples of enzymatic reactions and catalytic processes- Planning of green synthesis in a chemical lab.

UNIT – II
Greener reagents and reactions: Methods of designing safer chemicals. Examples of greener reagents including replacement of phosgene and solid state polymerizations.

Green reactions: Acyloin condensation, Aldol condensation, Arndt Eistert synthesis, Baker Venkatraman synthesis, Beckmann rearrangement, Clemmenson reduction and Baeyer Villiger oxidation.
UNIT - III
Basics of Medicinal chemistry: Classification of drugs- basics of molecular modeling and docking - prodrugs and soft drugs- types of pro drugs system.
Drug targets and drug solubility: Enzymes and enzyme inhibitor – competitive and non-competitive inhibitors – reversible and irreversible inhibitors – ligand receptor theories:- Clarke’s theory and Paton’s rate theory – effect of pH, pKa and polarity on drug solubility

UNIT – IV

UNIT – V
Clinical training and synthesis of drugs: Various phases in pre-clinical testing and clinical testing – designing organic synthesis – different types of synthesis – complexes and chelating agents – natural resources of lead compounds – extraction and isolation of bio active compounds.

TEXT BOOKS:

REFERENCES:
Semester -I

15CHP111 ORGANIC CHEMISTRY PRACTICAL-I 4H 2C
(QUALITATIVE ANALYSIS AND SINGLE STAGE PREPARATIONS)

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Scope
This practical deals with the qualitative analysis of various two component mixtures and preparation of organic compounds by standard organic reactions and to understand the basic principles of lab techniques adopted in laboratories.

Objectives
1. To provide the knowledge about the qualitative analysis by separation techniques of a two component mixture.
2. To develop skills for the preparation of organic compounds by name reactions.

Methodology
Blackboard teaching and Demonstration.

Contents

Analysis of two – component mixtures: Separation and characterization of compounds.

Note: Each student should analyze a minimum of six organic mixtures.

Preparations involving one stage comprising of the following process: Nitration, acylation, halogenation, diazotisation, rearrangement, hydrolysis, reduction, alklylation and oxidation and one preparation illustrating the following: Benzoin condensation, Canizzaro reaction, Perkin reaction, Reimer-Tiemann reaction, Sandmayer reaction, Fries rearrangement, Skraup synthesis - single stage.

Note: Each student should do a minimum of six preparations involving single stage.

REFERENCES:
Scope
This practical course deals with the quantitative analyses of organic compounds and double stage preparation of organic compounds by standard organic reactions.

Objectives
On successful completion of the course the students should have
i) Learnt about the quantitative analyses of organic compounds.
ii) Learnt the two stage preparation of organic compounds by important name reactions.

Methodology
Blackboard teaching and Demonstration.

Contents
Estimation of phenol, Ethyl methyl ketone, glucose, nitro, amino and methoxy groups, unsaturation in an organic compound.

Analysis of oils Reichert- Meissl value, Iodine value, saponification value and acetyl value.
Double stage preparations- Anthranilic acid and pthalimides.

Extraction and estimation of active constituents
Only for learning purpose and demo (Not for exam)
   a. Lactose from milk.
   b. Caffeine from tea.
   c. Nicotine from tobacco extract.
   d. Citric acid or ascorbic acid from a tablet or from a natural source.
   e. Curcumin from turmeric.
   f. Lycopene from tomato.

REFERENCES:
Semester - II

15CHP201 ORGANIC CHEMISTRY-II 5H 5C
(REARRANGEMENTS, REACTIONS, PHOTOCHEMISTRY AND PERICYCLIC REACTIONS)

Instruction Hours/week: L: 4 T:1 P:0 Marks: Internal:40 External: 60 Total:100

Scope
The course provides the knowledge about the basics of organic chemistry, which involves rearrangements, conformational analysis, stereochemistry, principles of various organic radical, concerted and photochemical reactions and outlines of the mechanism and discusses the application of reactions.

Objectives
On successful completion of the course the students should have
1. A versatile knowledge of rearrangements, different organic (radical and concerted) reactions and their applications in synthesis.
2. Understood the principles of conformational analysis and stereochemistry.
3. Mastered photochemical reactions.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Molecular rearrangements: Intramolecular 1,2 - shifts - Wagner - Meerwein and Pinacol-Pinacolone rearrangements.
Migration to carbonyl carbon – Demyanov and Neber rearrangements.
Non-cyclic rearrangements – Chapman and Wallach rearrangements.

UNIT – II
Conformational analysis and stereochemistry: Stereochemistry of sulphur and nitrogen compounds, stereoselective and stereospecific reactions - R/S-notation of optically active carbon compounds. Optical isomerism of biphenyls, allenes and spiranes.

UNIT – III
Radical reactions: Configuration and generation of short lived free radicals- characteristics of free radical reactions – radical substitution, radical additions and rearrangement of free radicals. Typical reactions such as Sandmeyer, Gomberg, Pechmann, Ullmann, Pschorr and Hunsdiecker reactions.
Oxidation and reductions - mechanisms – aromatisation, oxidation of alcohols and glycols, ozonolysis, Sommelet reaction and selectivity in reduction-metal hydride reduction- reduction of nitro compounds and acyloin condensation.

UNIT – IV


UNIT – V


TEXT BOOKS:

REFERENCES:
Semester-II

15CHP202 INORGANIC CHEMISTRY- II (CO-ORDINATION CHEMISTRY)

Instruction Hours/week:L: 4 T:1 P:0 Marks: Internal:40 External: 60 Total:100

Scope
Coordination chemistry is an exciting and challenging experimental science, which helps us to understand our world. Being the complex compounds it deals with the study of metals with ligands. Coordination chemistry is a big part of our daily life and present in many biological systems. Its reactions and properties are unique in nature.

Objectives
1. To understand the theories of bonding in coordination compounds.
2. To study the kinetics and mechanisms of reactions of complex compounds.
3. To understand the magnetic properties of coordination compounds.
4. To learn about the coordination compounds present in the biological systems and their functions.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT-I
Coordination Chemistry: Nomenclature, Isomerism and methods of preparation of coordination complexes- types of ligands.

UNIT-II

UNIT-III

UNIT-IV
Carbocyclic pi complexes: Cyclopendienyl and related complexes synthesis, bonding, structure and reaction. Arene complexes-Complexes of biochemical importance:
Cytochromes, Haemoglobin, Myoglobin, Cyanocobalamine, Chlorophyll- structure and functions.

UNIT-V

**Reaction of coordination compounds:** Substitution reactions in square planar and octahedral complexes – Trans effect – mechanism of redox reactions.

Homogeneous catalysis by coordination compounds – hydroformylation – carboxylation of methanol – hydrogenation of unsaturated organic compounds.

**TEXT BOOKS:**

**REFERENCES:**
Scope

Chemical kinetics and electrochemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Chemical kinetics is an exciting and challenging course, which helps us to understand the various aspects of corrosion and catalysis. Electrochemistry is a part of our daily life. Chemistry interfaces with a myriad of other disciplines and fields. They are fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of chemical kinetics and electrochemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of these subjects would not diminish over time, so it will remain a promising career path. It deals with catalysis, corrosion and polarography.

Objectives

1. To provide knowledge on fundamental understanding of chemical kinetics and to establish a relationship between the rate of reaction and the concentration of the reactants (the rate law, or rate equation).
2. To provide knowledge to the students about different experimental facilities including shock tubes, flow reactors, jet-stirred reactors and relaxation methods etc.
3. To study the adsorption, classification of adsorption and factors affecting adsorption.
4. To study the theories of catalysis and types of catalysis.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT-I

Theories of reaction rates: Arrhenius theory- hard - sphere collision theory of gas – phase reactions. Activated complex theory or Absolute reaction rate theory (ARRT) for ideal gas reactions (in terms of partition functions).
Reactions in solution: Comparison between gas-phase and solution reactions. The influence of the solvent on the reactions between ions. Influence of ionic strength on rates of reactions in solution - Primary salt effect-influence of pressure on rates of reactions in solution -significance of volume and entropy of activations.
Study of Fast reactions: Flow methods, pulse methods, relaxation methods, shock-tube method and nuclear magnetic resonance method.
UNIT-II

UNIT-III

UNIT – IV

UNIT – V

TEXT BOOKS:

REFERENCES:
Scope
Chromatographic techniques frame much of our understanding of the natural world and continue to bring new technologies that are useful to every aspect of human life. Chromatographic techniques is an exciting and challenging course, which helps us to understand the various aspects of separations used in our day to day life. Chromatographic techniques interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry. Due to highly prized nature of Chromatographic techniques and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the different techniques

Objectives
1. To make non-chemistry graduates to get exposed to different chromatographic techniques.
2. To learn the terms and definitions in general chemistry and use of popularly used chemicals.
3. To enable the student to understand about instrumentation in chromatography.

Methodology
Self study

UNIT- I
Chromatographic methods, general aspects of chromatography, classification and types, mechanism.

UNIT- II
Column chromatography, construction and operation of column, choice of adsorbent elements, applications. Ion exchange chromatography : Anion and cation exchangers techniques applications.

UNIT- III
Paper chromatography: Mechanism of separation, development and applications. Thin layer chromatography: Techniques, choice of adsorbent solvents and applications.

UNIT- IV
UNIT -V

TEXT BOOKS:

REFERENCES:
**Scope**
This paper gives a concise idea of heterocyclic compounds, organic synthesis and synthetic reagents. This paper also deals with chemotherapy and vitamins.

**Objectives**
On successful completion of the course the students should have:
- 1. Mastered heterocyclic compounds, synthetically important name reactions in organic chemistry and synthetic reagents.
- 2. Understood the composition of chemotherapy.
- 3. Learnt scientific methods to synthesize vitamins.

**Methodology**
Blackboard teaching, Powerpoint presentation and group discussion.

**UNIT-I**
**Heterocyclic compounds:** Nomenclature-methods of preparation and important reactions of indole, pyrazole, imidazole, quinoline, isoquinoline, uric acid and adenine. Structure elucidation of caffeine. A general study of flavones, isoflavones and anthocyanins – structure and synthesis of quercetin and cyanidin chloride.

**UNIT-II**
**Reagents in organic synthesis:** Use of the following reagents in organic synthesis and functional group transformations: Gilmans reagent, Diazomethane, N-Bromosuccinimide, Lead Tetraacetate, Raney Nickel, Trimethylsilyl Iodide, Tri-n-Butyltin hydride, Periodic Acid, Sodium Amide, Jones reagent, Wilkinsons catalyst, 1,3-dithiane and Fenton’s reagent.

**UNIT-III**
**Some typical reactions and their applications in organic synthesis:** C-C and C=C bond forming reactions-Vilsmeier – Haack, Shapiro, Wittig – Horner, Peterson synthesis and Heck reactions. Ring formation by Robinson annulation Simmons-Smith reaction.

Woodward Prevost hydroxylation, Oppenauer oxidation, Birch reduction, Clemmenson reduction, Wolff Kishner reduction, Sharpless asymmetric epoxidation.
UNIT-IV

UNIT- V
Vitamins: Structure and synthesis of vitamin B complex : Vitamin B1 (aneurin) - vitamin B2 (riboflavin) - pantothenic acid - folic acid - vitamin H (biotin) - vitamin B6 (pyridoxine) - vitamin E (tocopherol) - vitamin K1 (phyllloquinone) and vitamin K2.

TEXT BOOKS:

REFERENCES:
ELECTIVE-I  
15CHP204B  
ANALYTICAL CHEMISTRY  

Instruction Hours/week: L: 4 T:0 P:0  Marks: Internal:40 External: 60 Total:100

Scope
Analytical chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Analytical chemistry is an exciting and challenging course, which helps us to understand the various aspects of quality. Analytical chemistry is a part of our daily life. Analytical chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Analytical chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. It deals with chromatographic methods, inorganic qualitative analysis and electrochemical methods of analysis.

Objectives
1. To learn about quantitative inorganic analysis.
2. To understand the different colorimetric analysis.
3. To learn about electrochemical methods of analysis.
4. To learn different chromatographic techniques.
5. To understand how to analyse the data obtained.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT-I

UNIT-II
UNIT-III

UNIT-IV
Electrochemical Methods of Analysis: Cyclic Votammetry, Coulometry and amperometry-principle and applications.

Thermal Characterization techniques: Principle and applications of Differential Thermal Analysis (DTA), Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration.

UNIT- V
Chromatographic Methods: Classification – techniques and applications in column, size-exclusion, ion exchange, paper and thin layer chromatography.
Gas chromatography and high performance liquid chromatography (HPLC)-principle, equipment design, sample injection system, columns, detectors and applications.

TEXT BOOKS:

REFERENCES:
Scope
Organometallic chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Organometallic chemistry is an exciting and challenging course, which helps us to understand the various aspects of metals in biological systems. Organometallic chemistry is a part of our daily life. Organometallic Chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of organometallic chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. It deals with different types of metallic complexes with organic ligands.

Objectives
1. To learn about nature of the bonding between organic ligands and metals.
2. To understand about the metal alkyl complexes.
3. To learn about the alkene and cyclopentadienyl complexes.
4. To understand about the usage of organometallic compounds as catalysts.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

UNIT- II
**Metal alkyl complexes:** Stability and structure - synthesis by alkylation of metal halides - by oxidative addition - by nucleophilic attack on coordinated ligands - metal alkyl and 18 electron rule - reactivity of metal alkyls - M-C bond cleavage reactions - insertion of CO to M-C bonds - double carbonylation - insertions of alkenes and alkynes - insertions of metals with C-H bonds - alkylidene and alkylidyne complexes - synthesis of alkylidene complexes in low oxidation states and in high oxidation states - bonding in
alkylidene complexes - synthesis and bonding in alkylidyne complexes - reactivity of alkylidene and alkylidyne complexes.

UNIT- III

UNIT- IV

UNIT - V
Organometallic compounds in homogeneous catalytic reactions: Coordinative unsaturation - acid-base behaviour reaction - migration of atoms or groups from metal to ligand - insertion reaction - reactions of coordinated ligands - catalytic reactions of alkenes - isomerisation of alkenes - hydrogenation - hydroformylation and hydrosilation of alkenes - alkene polymerisation and oligomerisation - fluxional molecules.

TEXT BOOKS:

REFERENCES:
Scope
Advanced coordination chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Advanced coordination chemistry is an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. Advanced coordination chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry. Due to highly prized nature of advanced coordination chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path.

Objectives
1. To quantify bonding parameters in cubic and distorted geometries from absorption spectra.
2. To identify coordination compounds with noble electrochemical and photochemical properties suitable for the construction of supramolecular assemblies and nanostructures.
3. To envision the importance of inorganic photosensitizers for solar energy conversion.
4. To identify complexes suitable for application in medicinal inorganic chemistry.
5. To set research goals in the highly topical areas of coordination chemistry.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I
Electronic Structure and Geometry of Coordination Compounds: Electronic spectroscopy: crystal field spectra of Oh and Td complexes, effect of distortion on the spectra, structural evidence from electronic spectra, evaluation of $\Delta o$ values in Co(III) and Ni(II) Oh and Td complexes, quantification of covalency nephelauxetic ratio.

Nuclear magnetic resonance spectroscopy: application of spin-spin coupling to inorganic structural determinations, NMR spectra of quadrupolar nuclei, NMR of paramagnetic transition metal complexes: scalar shift and pseudocontact shift, scalar shift and covalency.

Electron spin resonance spectroscopy: hyperfine and zero field effects on the epr spectra of coordination compounds, ligand field interpretation of the g- and A- tensors, nuclear quadrupole interaction.
Mossbauer spectroscopy: quadrupole and magnetic interactions, isomer shift and site symmetry of metal ions in coordination compounds, Mossbauer emission spectroscopy and applications.

UNIT- II

Solar and renewable energy: light- to-chemical energy conversion in lamellar solids and thin films, solar energy conversion by dye-sensitized photovoltaic cells and by coordination compounds anchored onto semiconductor surfaces.

Photochemistry of lanthanide complexes: A-ET-E processes, NIR- to-visible photon up conversion, nonlinear optical behavior, exciting multiplication and relaxation dynamics in quantum dots and applications.

UNIT- III
Supramolecular Assemblies and Devices: Supramolecular assemblies: design principles, homo- and heteropoly metallic polypyridyl systems, inter component energy and electron transfer, role of bridging ligands.

Dendrimers and metallodendrimers: synthetic methodology-divergent and convergent methodologies; types of metallodendrimers, dendrimer encapsulated catalysis.

Molecular devices: supramolecular photochemistry, photo- and electrochemical sensors, molecular electronic devices.

UNIT-IV

Bioredox agents: rubredoxins and ferredoxins- functions and structural features.

Contrast enhancing agents for MRI: theory of MRI imaging, synthesis of Gd-based contrast agents.

Metal complexes for radiotherapy: diagnostic radiopharmaceuticals, non- technetium for diagnostic imaging, Tc-labelled small molecules and peptides as diagnostic radiopharmaceuticals.

Metal complexes as photosensitizers.
UNIT-V

Synthesis of Novel Coordination Compounds and Assemblies: Synthesis of Schiff base macrocycles and macrocyclic binucleating ligands by coordination template effects.

Polyazamacrocycles and macrocycles with pendant arms.

Construction of polynuclear supramolecular assemblies and nanostructures.

TEXT BOOKS:

REFERENCES:
ELECTIVE-I  
Semester - II  
15CHP204E  
ORGANIC CHEMICAL TECHNOLOGY  
4H 4C  

Instruction Hours/week: L: 4 T:0 P:0  
Marks: Internal:40 External: 60 Total:100

Scope
Organic chemical Technology frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Organic chemical Technology is an exciting and challenging course, which helps us to understand the various aspects of metals in biological systems. Organic chemical Technology is a part of our daily life. Organic chemical Technology interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Organic chemical Technology and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. It deals with different types of

Objectives
1. To understand the elements of chemical engineering in organic synthesis.  
2. To know the unit processes in organic chemical technology.  
3. To understand the techniques involved in typical organic synthesis.  
4. To know the thermodynamics in organic unit processes.  
5. To apply the knowledge of chemical reactions in organic synthesis.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT– I


UNIT- II


Mass transfer: Distillation- two and three component systems. Ideal and non- ideal systems, various types of fractioning columns. Calculation of HETP from distillation curves. Leaching and extract ion based on process parameters.

Filtration and Drying: Select ion of proper equipment for above operations.
UNIT- III
Applications of Thermodynamics in Organic Unit Processes: Energy balance over a flow system, heat of reaction, effect of temperature upon heat of reaction. Chemical equilibrium, calculation of equilibrium conversion, entropy changes, simultaneous reactions, vapour phase and liquid phase catalytic reaction.

Organic Chemical Process Kinetics: Factors affecting chemical processes. Type and shape of reactors used, the method of operation, temperature control. Batch or flow process, batch mixing, fixed or fluidized bed.

UNIT- IV
Unit Process in Industrial Organic Synthesis: Study of Organic reactions as they apply to industrial processes. Process parameters of importance in scaling up of these reactions from laboratory to pilot plant to main plant.

Select ion of suitable plant equipment, especially the shape and size of the reactor stirrer, condenser etc. choice of material of construction.

Study of industrial scale nitration, sulphonation, homogeneous and heterogeneous hydrogenation, oxidation and halogenation reactions.

UNIT-V
Study of Detailed Technologies of Manufacture- a dye, a drug and a pigment: Three specific chemicals, one each from the above category will be discussed, illustrating the chemical engineering principles used in proper selection of equipment.

The logic involved in the layout of the plant, the control tests for the process itself and isolation methods of the product and its standardization.

Importance of quality control and technical service to customers will be pointed out.

TEXT BOOKS:

REFERENCES:
Scope
This Practical deals with the semi micro-qualitative analysis and spot tests of mixtures of familiar cations and non familiar cations and to motivate the students to understand the basic principles of lab techniques adopted in laboratories.

Objectives
On successful completion of the course the students should have
i) Learnt about the qualitative analysis by semi micro-qualitative analysis method.
ii) Learnt the preparation of inorganic complexes.

Methodology
Blackboard teaching and Demonstration.

Contents
Thallium, Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, titanium, Zirconium, Vanadium, Beryllium, Uranium and Lithium.

Note: Each student should analyze a minimum of six inorganic mixtures.

About ten preparations involving different techniques selected from the following:
Lead tetra acetate, dipyridinium hexaplumbate, hydroxylamine hydrochloride, ortho and para- hydroxy phenyl mercuric chloride, potassium cupric chloride, chrome alum, copperI chloride, tris(thio urea) copper(I) Chloride, potassium trioxalato- aluminato(III), potassium trioxalato-chromate(III), potassium trioxalato- ferrate(III), hexammine cobalt(III)chloride, chloropentammine chromium(III), chloro aquo pentammine chromium(III) nitrate, tetrammine copper(II) sulphate, ammonium hexa chloro stanate(IV).

Note: Each student should do a minimum of ten preparations.

References:
Scope
This Practical deals with the quantitative analysis of metals volumetrically and gravimetrically. Further it deals with quantitative analysis using chromatographic methods. On successful completion of the course the student can work in the Chemical industry and Pharmaceutical Company as a quality control officer, Chemist etc.

Objectives
On successful completion of the course the students should have
(i) Learnt about the quantitative analyses and Chromatography.
(ii) Learnt the estimation metals in a mixture by volumetric and gravimetric analysis.

Methodology
Blackboard teaching and Demonstration.

Contents
Analysis of mixture of ions – Volumetry and Gravimetry. Any four Complexometric titration- estimation of Zinc, nickel, magnesium and calcium ions using Eriochrome black-T or muroxide indicator.

Titrimetry: Oxidation using ceric and vanadium salts.

Chromatography: Column, Paper and Thin layer chromatography.

Titrations in non aqueous solvents.

Preparation, analysis and study of co-ordination complexes (any 5).

REFERENCES:
15CHP301  ORGANIC CHEMISTRY- III
(NATURAL PRODUCTS)

Instruction Hours/week:L: 4 T:0 P:0  Marks: Internal:40 External: 60 Total:100

Scope
Natural product chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Natural product chemistry is an exciting and challenging course, which helps us to understand the various aspects of natural products in biological systems. Natural product chemistry is a part of our daily life. Natural product Chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Natural product chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. The course gives the knowledge about the basics of chemistry of natural products, terpenoids, steroids, alkaloids, proteins and route to organic synthesis with the help of novel reagents.

Objectives
On successful completion of the course the students should have
1. Versatile knowledge about the isolation, synthesis, bio- synthesis and elucidation of various natural products.
2. Learnt the identification of molecular structures.
3. Mastered synthetically important reagents.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT-I

UNIT-II

UNIT-III
Alkaloids: Definition of an alkaloid-extraction of alkaloids-general properties - general methods of determining structure of alkaloids – structural elucidation and synthesis of Atropine, Morphine and Quinine -biosynthesis of quinoline alkaloids.
UNIT-IV


UNIT- V

Reagents in organic synthesis: Preparations and synthetic applications of DDQ, DBU, Ozone, Diborane, Osmium tetroxide, Selenium dioxide, Dicyclocarbodiimide (DCC), LDA, DIBAL-H and Mercuric acetate.

TEXT BOOKS:

REFERENCES:
Scope
Statistical thermodynamics frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Statistical thermodynamics is an exciting and challenging course, which helps us to understand the various aspects of physical chemistry. Statistical thermodynamics is a part of our daily life. Statistical thermodynamics interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Statistical thermodynamics and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path. This paper describes laws of thermodynamics and various co-efficient involved in thermodynamics with respect to their applications.

Objectives
1. To develop a knowledge in the interpretation of various physical quantities involved in the thermodynamics.
2. To learn the fundamental process involved in thermodynamics and their applications.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Thermodynamics and Non-ideal systems: Chemical potential and the definition of fugacity. Determination of fugacity of gases by graphical method and from equations of state. Variation of fugacity with temperature. Fugacity and the standard states for non ideal gases.

UNIT – II
UNIT – III


UNIT – IV


UNIT – V


TEXT BOOKS:

REFERENCES:
Scope
Physical methods in chemistry frame much of our understanding of the natural world and continue to bring new technologies that are useful to every aspect of human life. Physical methods in chemistry are an exciting and challenging course, which helps us to understand the various aspects of compounds in biological systems. Physical methods in chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Natural product chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the basic principles of chromatographic methods and spectroscopic techniques.

Objectives

1. To learnt about the various methods involved in analytical techniques like thermal analysis, electron microscopy and circular dichorism.
2. To learn about the ESR spectroscopy.
3. To understand different chromatographic methods.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Chromatography: Theory, instrumentation, basic principles & application in the chemical analysis of the following – columns, paper, thin layer and ion exchange-gel permeation-HPLC applications in chemical analysis-gas chromatography.

UNIT – II
Thermal analysis: Differential thermal analysis DTA and differential scanning calorimetry DSC - basic principles - thermo gravimetric analysis.


Auger electron spectroscopy AES and Ultra-Violet photo electron spectroscopy UPS/PES principles and applications.
UNIT – III  
**Circular Dichroism and Optical Rotatory Dispersion:** Basic principles - Cotton effects-Octants rule –axial halo ketone rule-application of ORD and CD. Tyndal Scattering-turbidimetry and nephelometry-applications. Atomic Absorption Spectroscopy.

UNIT – IV  
**ESR spectroscopy:** Theory - derivative curves - g shift - hyperfine splitting-isotropic and anisotropic systems-zero field splitting and Kramer degeneracy. Identification of free radicals – applications to copper complexes.

UNIT – V  
**Flame Emission Spectroscopy:** Introduction, Flames and flame spectra, Flames temperature, Chemical reaction in flame and flame background. Flame photometers, Flame spectrophotometers, Photosensitive detectors, Single beam and double beam instruments, calibration curve, Errors in flame photometers, applications.

**TEXT BOOKS:**

**REFERENCES:**
Scope
Polymer and Nano chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Polymer and Nano chemistry is an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. Polymer and Nano chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Natural product chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the basic principles of polymers, polymer products and nano particles.

Objectives
1. To understand the basic concepts of polymerization, plastic and fibre technology.
2. To kindle interest in students in learning Nanochemistry.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I
Radical chain polymerization: Kinetic scheme for polymerization in presence of initiator.
Ionic chain polymerization: Comparison of radical and ionic polymerizations.
Chain copolymerization: Types of copolymers, the copolymer equation, the Q-e scheme and rate of copolymerization. Ziegler-Natta catalysis and polymerization.

UNIT - II
Polymer additives – use of fillers in plastics – antioxidants and other stabilizers – plasticizers – effect of plasticizers on polymer properties (Tg. Fluidity, mechanical properties and dielectric properties) – use of flame retardants and colourants.
UNIT - III  
**Fibre technology:** Production of natural and synthetic fibre, cellulosic fibres, polyamide fibres, polyester and acrylic fibres. Properties of textile fibres – criteria for fibre formation orientation of molecules on drawing. Spinning processes – melt spinning- dry spinning and wet spinning.

UNIT- IV  
**Nano materials:** Preparation: - plasma assisted chemical vapour deposition-sol-gels-electro deposition. Carbon nano materials: New form of carbon-fullerene \( \text{C}_{60} \) nano tubes-types of nano tubes-single walled nano tube-multi walled nano tube. Formation, purification, properties and uses of nano tubes.

UNIT- V  
**Molecular nanotechnology:** Scanning electron microscope (SEM) - modern transmission electron microscope (TEM) - Atomic force microscope (AFM)-scanning tunneling microscope (STM).

TEXT BOOKS: 

REFERENCES: 
Scope
Polymer Chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Polymer Chemistry is an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. Polymer chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of Polymer chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the basic principles of polymerization, coordination polymerization, determination of molecular weight of polymers, properties of polymers.

Objectives
1. To learn about the basic concepts of kinetics and mechanism of polymerization.
2. To learn about the coordination polymerization.
3. To understand the Molecular weight of the polymers and their properties.
4. To learn about the processing of polymers.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

UNIT – II

UNIT – III
structure and physical properties – crystalline melting point Tm. The glass transition temperature. Determination of Tg. Relationship between Tm and Tg.

UNIT – IV
**Polymer Processing:** Plastics, elastomers and fibres. Compounding, processing techniques: calendering, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion, moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT – V
**Properties of Commercial Polymers:** Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers, Fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

**TEXT BOOKS:**

**REFERENCES:**
Scope
Textile Chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Textile Chemistry is an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. Textile chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry. Due to highly prized nature of Textile chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the classification of fibres, Dyeing of fabrics and related process.

Objectives
1. To learn about the classification of fibres
2. To learn about the dyeing process on fibres.
3. To learn the effluent treatment from an fibre industry.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I
Fibres: General classification of fibres-chemical structure, production, properties and uses of the following natural fibres (a) natural cellulose fibres (cotton and jute) (b) natural protein fibre (wool and silk).

Chemical structure, production, properties and uses of the following synthetic fibres. (i) Man made cellulosic fibres (Rayon, modified cellulose fibres) (ii) Polyamide fibres (different types of nylons) (iii) Poly ester fibres.

UNIT- II

Dyeing - Dyeing of wool and silk –Fastness properties of dyed materials – dyeing of nylon, terylene and other synthetic fibres.

UNIT- III
Finishing: Finishes given to fabrics- Mechanical finishes on cotton, wool and silk, method used in process of mercerizing –Anti-crease and Anti-shrink finishes –Water proofing
UNIT-IV

Diphenylmethane Dyes- Auramine-Triphenylmethane Dyes-Malachite Green, Crystal Violet, Pararosaniline-Preparation and applications.

Indigo Dyes-Preparation and application-Derivatives of Indigo- Synthesis and uses of Indigosol and tetrahaloindigo.

Phthalein Dyes-Phenolphthalein- Preparation and applications.

Xanthene Dyes-Rhodamine B, Fluorescein-Eosin- Preparation and applications.

UNIT-V

TEXT BOOKS:

REFERENCES:
**ELECTIVE-II**
**Semester - II**
**15CHP305C**
**INDUSTRIAL CHEMISTRY**
**(APPLIED BIOINORGANIC CHEMISTRY, INORGANIC DRUG TARGETS AND METALS IN MEDICINE)**

**Instruction Hours/week:** L: 4 T:0 P:0  **Marks:** Internal:40 External: 60 Total:100

**Scope**

Industrial chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Industrial chemistry is an exciting and challenging course, which helps us to understand the various aspects of corrosion and catalysis. Industrial chemistry is a part of our daily life. Due to highly prized nature of Industrial chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines as pharmaceutical, agrochemical, mineralogy, molecular biology, biotechnology, nanotechnology, polymer technology, teaching research, scientific publication and so on. The importance of this subject would not diminish over time, so it will remain a promising career path. It deals with applied bioinorganic chemistry and about drug targets and metals in medicine.

**Objectives**

1. To give the knowledge of the basic principles and concepts of industrial chemistry (applied bioinorganic chemistry, inorganic drug targets and metals in medicine).
2. To provide a fundamental introduction of metals in human body and its function.
3. To learn about the physical methods in bioinorganic chemistry, metal biomolecules interactions, complexes, and drug discovery.

**Methodology**

Blackboard teaching, Powerpoint presentation and group discussion.

**UNIT- I**

**Metals in the Human Body:** General principles - the elements in the human body - biological significance, storage and transport of Fe, Zn, Cu, Mo, Co, Cr, V and Ni - metal functions in metalloproteins - metallo enzyme functions - supplying elements to the body - metals and human health.

**UNIT- II**


**UNIT- III**

**Binding of Metal Ions and Complexes to Biomolecules:** Nucleic acid structures - fundamental interactions with nucleic acids - binding interactions of tris(phenanthroline) metal complexes with DNA - techniques to monitor binding - applications of metal complexes that bind to nucleic acids - biopolymer promoted metal ligand interactions.
UNIT- IV
Complexes and Cheating Agents: Labile and inert complexes - metal-ligand selectivity-HSAB approach-chelate effect and Irving-William series -survey of metals used for diagnosis and chemotherapy-radiodiagnostic agents-Magnetic Resonance Imaging(MRI) - gold and other metal phosphines-main-group and transition metal compounds -miscellaneous metals in medicine-chelating agents and therapy - EDTA-evolution, chemical properties, in vivo chelation of radionuclides, dosage and toxicity.

UNIT-V
Drug Discovery and Design: Outline- therapeutic index, chemotherapeutic index, structure-activity relationship (SAR) and quantitative structure-activity relationship (QSAR)- Factors governing drug design- Computer aided drug design-Cancer chemotherapy-bioinorganic chemistry (DNA binding) of platinum anticancer drugs (cisplatin and carboplatin)-mechanism of action studies-clinical trials and their significance- production and quality control- patent protection.

TEXT BOOKS:

REFERENCES:
Scope

Applied Chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Applied Chemistry is an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. Applied chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry. Due to highly prized nature of applied chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the knowledge about industrial fuels, Chemistry and agriculture, Chemistry in sugar industry, high polymers and in products used in our day to day life.

Objectives

1. To make non-chemistry graduates to get exposed to day to day chemistry related materials and science.
2. To learn the terms and definitions in general chemistry and use of popularly used chemicals.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

**Industrial Fuels:** Energy sources: non-renewable, classification of fuels, solid, liquid and gaseous. Calorific value of fuels and its determination.
- Solid fuels: Coal: types, properties and uses of lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal.
- Gaseous fuels: Natural gas and gobar gas: production, composition and uses, Gobar electric cell.

UNIT- II

**Chemistry and agriculture:** Fertilizers: Discussion on ammonium nitrate, urea, superphosphate, triple superphosphate, diammonium phosphate, potassium nitrate, uses of mixed fertilizers, micronutrients and their role.
- Pesticides: Classification of pesticides with examples.
- Insecticides: stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC(gammexane: conformation of gamma isomer) pyrethrin mention of aldrin, dieldrin, endrin and pentachlorophenel ( and its Na salt) (structures excluded)
- Herbicides: 2,4-D and 2,4,5-T.
Fungicides: Bordeaux mixture, mention of lime sulphur, creosote oil and formula.

UNIT- III
Sugar and Paper industry: Sugar industry: Double sulphitation process, refining, and grading of sugar.
Saccharin: synthesis and uses as a sugar substitute. Ethanol: manufacture from molasses by fermentation.
Paper industry: Manufacture of paper: production of sulphite pulp and conversion to paper (bleaching, filling, sizing and calendaring)

UNIT-IV
High Polymers: Classification, types of polymerization.
Natural polymers: polysaccharides (starch and cellulose), polyhydrocarbons (natural rubber) and proteins.
Synthetic polymers: Polyhydrocarbons (polythene, synthetic rubber), polychlorohydrocarbons (PVC, neoprene), polyamides (nylon) and polyphenols (phenolformaldehyde resin). Addition and condensation polymerization, step growth and chain growth polymers.
Fibres: rayon, terylene and nylon.

UNIT- V
Articles used in daily life: Glass: composition, manufacture and uses.
Cement: Manufacture: wet and dry processes, composition and setting of cement
Dyes: classification based on structure and application. Synthesis of congo red and malachite green.
Pharmaceuticals: Manufacture of aspirin and penicillin (fermentation process) mention of antibiotics.

TEXT BOOKS:

REFERENCES:
Scope
Printing chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Printing chemistry is an exciting and challenging course, which helps us to understand the various aspects of colours, colouring materials and printing. Printing chemistry is a part of our daily life. Printing Chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry, biology and medicine. Due to highly prized nature of printing chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path.

Objectives
1. To learn about nature of the bonding between organic ligands and metals.
2. To understand about the metal alkyl complexes.
3. To learn about the alkene and cyclopentadienyl complexes.
4. To understand about the usage of organometallic compounds as catalysts.

Methodology
Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

UNIT- II
Colour Description: Arrangement of colour, visual attribution of colour, Beer-Lambert’s law, colour primaries and color mixing, additive and subtractive color mixing. Applications in photography, electronic colour monitors and colour printing. Colour specification, colour order systems-Munsel colour order system and Ostwald colour order system.

UNIT- III
Colour measurement: Principles of colour measurement, Tristimulus values, CIE diagram, standard illuminant, standard observer and colour matching functions. Spectral reflectance, graphical representation and numeric representation. CIEXYZ and CIELab representation. Colour gamut, RGB, CMY and CYMK gamuts and limitations.
UNIT- IV

**Colour matching:** Definition. Manuel colour matching, single constant (K/S) Kubelka-Munk theory, spectral match, tristimulus match. Color matching and metamerism.


UNIT- V

**Color Differences:** Perceptibility and acceptability, methods of assessment, colour difference formula. Measurement of fluorescence- Visual photoelectric and spectrophotometric colourimeter. Advantage of spot spectral measurements- fibre optic spectrophotometer.

**TEXT BOOKS:**

**REFERENCES:**
Scope
Physical chemistry practicals frame much of our understanding of the natural world and continue to bring new technologies that are useful to every aspect of human life. Physical chemistry practicals are an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. This course presents the knowledge about thermal and conductometric titrations and solubility of a sparingly soluble salt.

Objectives
On successful completion of the course the students should have
(i) Learnt about the Thermal and conductometric titrations.
(ii) Learnt the Principles of solubility of a sparingly soluble salt.

Methodology
Blackboard teaching and Demonstration.

Contents
Heat of solution from solubility.

Molecular weight determination by
i. Freezing point depression of solvents benzene and water by Beckmann method
ii. By Rast micro methods

Distribution of activity and activity co-efficient by freezing point method.

Distribution co-efficient and determination of equilibrium constant.

Conductivity experiments:
Determination of
i) Equivalent conductance of a strong electrolyte and verification of Debye-Huckel Onsager law
ii) Verification of Ostwald dilution law and Kohlraush law for weak electrolytes.

Conductometric determination of Pka of a weak acid.

Hydrolysis constant of aniline hydrochloride.

Determination of the solubility of a sparingly soluble salt.
Conductometric titrations:

Acid-base and precipitation titrations including mixture of halides.

REFERENCES:
Semester-III

15CHP312 PHYSICAL CHEMISTRY PRACTICAL- II 4H 2C
(Chemical Kinetics and Potentiometric Titrations)

Instruction Hours/week: L: 0 T:0 P:4  Marks: Internal:40 External: 60 Total:100

Scope
Physical chemistry practicals frame much of our understanding of the natural world and continue to bring new technologies that are useful to every aspect of human life. Physical chemistry practicals are an exciting and challenging course, which helps us to understand the various aspects of compounds used in our day to day life. This course presents the knowledge about chemical kinetics and potentiometric titrations and adsorption experiments.

Objectives
On successful completion of the course the students should have
(i) Learnt about the Chemical Kinetics and Potenciometric titrations.
(ii) Learnt the Principles of Adsorption experiments.

Methodology
Blackboard teaching and Demonstration.

Contents

Electromotive force determination of standard potentials of Cu, Zn, Ag.

Determination of pH and pKa values using hydrogen and quinhydrone electrodes and glass electrode pH meter- potentiometric acid-base titrations.

Determination of formal redox potential of a redox system and redox titrations.

Determination of solubility product of a sparingly soluble salt concentration cell and chemical cell.

Determination of activity co-efficients from emf data.

Precipitation titration of a mixture of halides.

Chemical Kinetics:

i. Evaluation of Arrhenius parameters using acid hydrolysis of an ester.

ii. Base catalysed hydrolysis of an ester conductometrically.

iii. Rate of reaction between persulphate and iodide ions study of salt over the persulphate- iodide reaction.

Evaluation of catalytic constants for weak acids and verification of Bronsted catalysis law.
Adsorption Experiments:
Adsorption of oxalic acid and acetic acid on activated charcoal-Freundlich isotherm.

REFERENCES:
SELF STUDY COURSES  
15CHP306  
NANO TECHNOLOGY  
Semester-III  
4C

Instruction Hours/week: L: 0 T:0 P:0  
External: 100 Total:100

Scope
Nano Technology frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. Nano Technology is an exciting and challenging course, which helps us to understand the various aspects of separations used in our day to day life. Nano Technology interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry. Due to highly prized nature of Nano Technology and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the different techniques

Objectives
1. To learn about the classification and types of nanomaterials.
2. To understand about the carbon based nanomaterials.
3. To understand about the metallic and oxide based nanomaterials.

Methodology
Self study

UNIT- I  
**Nano technology**: Introduction-definition-origin of nanotechnology-difference between bulk and nanomaterials-size dependent properties (magnetic, electronic, transport and optical).

UNIT- II  
**Classification of nanomaterials**: Classification based on dimensional property - zero D, 1D, 2D and 3D nanostructures.

UNIT- III  
**Types of nanomaterials**: Metal oxides and metal nano particles-ceramic nano particles-semi conducting quantum dots-coreshell, quantum dots-nanocomposites - micellar nanoparticles

UNIT- IV  
**Carbon based nanomaterials**: Fullerenes- Carbon nanotubes-single walled and multiwalled nano tubes- structures-carbon nanofibre.

UNIT- V  
**Metallic and oxide based nanomaterials**: Metallic and oxide based nanomaterials – ceramic oxide nanomaterials – semiconductor oxide nanomaterials – nanocomposites and core-shell nanomaterials – micellar nanomaterials.
TEXT BOOKS:

REFERENCES:
Scope
An analytical technique in chemistry frames much of our understanding of the natural world and continues to bring new technologies that are useful to every aspect of human life. An analytical technique in chemistry is an exciting and challenging course, which helps us to understand the various aspects of separations used in our day to day life. Analytical techniques in chemistry interfaces with a myriad of other disciplines and fields. It is fundamental to understand other areas of chemistry. Due to highly prized nature of Analytical techniques in chemistry and its diverse topics, it lays the foundation for extremely productive and exciting career in variety of disciplines. The importance of this subject would not diminish over time, so it will remain a promising career path. This course presents the different techniques

Objectives
1. To learn UV-Visible, IR and Raman spectroscopic analysis.
2. To learn NMR of $^1$H, $^{13}$C, $^{31}$P, $^{19}$F.
3. To learn the ESR Spectroscopy and the magnetic property of molecules.
4. To understand different thermal methods.

Methodology
Self study

UNIT- I
Analytical Chemistry: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

UNIT- II
Infrared spectrophotometric analysis – principle and instrumentation and molecular structure determination.
Raman Spectra – principle, basic instrumentation – structural analysis.

UNIT- III
NMR, NQR and Mossbauer Spectroscopy: Nuclear Magnetic Resonance – Principle, instrumentation, structure determination. NMR of $^1$H, $^{13}$C, $^{31}$P, $^{19}$F.
NQR - Nitrosyl compounds, Mossbauer of Fe and Sn systems.
UNIT- IV
**Electron Spin Resonance:** Principle, instrumentation, applications to coordination compounds.
Magnetic Susceptibility and measurements - Guoy method, Faraday method-applications.

UNIT-V
**Thermal Analysis:** Thermo gravimetric and differential thermal analysis, thermometric titrations, differential scanning colourimetry – basic instrumentation and applications.

TEXT BOOKS:

REFERENCES: