M.Sc. (Chemistry) I-IV Semester

Course and Examination structure

M.Sc. Previous – First Semester		**Maximum Marks**
CHE 101 Paper –I	Inorganic Chemistry I	75
CHE 102 Paper -II	Organic Chemistry I	75
CHE 103 Paper -III	Physical Chemistry I	75
CHE 104 Paper- IV	Analytical Techniques	75
CHE 105 Practical	Chemistry Practical-I	150

M.Sc. Previous- Second Semester		
CHE 201 Paper –I	Inorganic Chemistry II	75
CHE 202 Paper -II	Organic Chemistry II	75
CHE 203 Paper -III	Physical Chemistry II	75
CHE 204 Paper- IV	Spectroscopic Methods	75
CHE 205 Paper -V	Practical-II	150

M.Sc. Final- Third Semester		**Maximum Marks**
Specialization Papers		
CHE 301 Paper –I	Chemistry (I/O/P)[#]	75
CHE 302 Paper -II	Chemistry (I/O/P) [#]	75
CHE 303 Paper -III	Chemistry (I/O/P) [#]	75
Elective Papers		
CHE 304 Paper – IV	Elective Paper I*	75
CHE 305 Practical-III		150

M.Sc. Final- Fourth Semester

Specialization Papers

CHE 401 Paper –I	Chemistry (I/O/P) #	75
CHE 402 Paper -II	Chemistry (I/O/P) #	75
CHE 403 Paper -III	Chemistry (I/O/P) #	75

Elective Papers

CHE 404 Paper IV	Elective Paper II**	75
CHE 405 Practical-IV		75
CHE 406 Project Work		75

Students have to opt any one Specialization from I/O/P

(I/O/P) Inorganic Chemistry / Organic Chemistry / Physical Chemistry

* Students have to choose any one Elective Paper from Solid State and Nuclear Chemistry / Biophysical Chemistry / Environmental Analysis & Monitoring

** Students have to choose any one Elective Paper from Environmental Chemistry / Reagents and Reactions / Nuclear Chemistry and Radiochemical Analysis

M.Sc. – First Semester

CHE 101 PAPER –I INORGANIC CHEMISTRY I (40 hrs)

UNIT – I

Metal – Ligand Bonding in Transition Metal Complexes

Crystal field effect: Splitting of d orbital in Octahedral, Tetrahedral and Square planner symmetry; Crystal Field Stabilization Energy; Jahn-teller distortions.

UNIT - II

Molecular orbital theory

Molecular orbital theory and its applications to metal complexes.

UNIT - III

Molecular Symmetry and Character Tables

Symmetry elements and symmetry operations, symmetry groups, Defining properties of a group, character tables and its application.

UNIT - IV

Symmetry in inorganic molecules, Symmetry consideration in simple inorganic and coordination compounds.

UNIT - V

Molecular Luminescence

Principles of fluoresence and phosphorescence, Photolumionescence spectra of transition metal (d^{10}) and lanthanides complexes.

CHE 102 PAPER -II ORGANIC CHEMISTRY I (40 hrs)

UNIT – I

Aromaticity and π-Molecular Orbitals of Conjugated Systems

Aromaticity in benzenoid, non-benzenoid compounds and metallocenes, Huckels rule, energy of pi-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity.

Reaction Mechanism: Structure and Reactivity

Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects, Product analysis, Kinetic and stereo chemical studies.

UNIT – II

Stereochemistry

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, optical purity, enantiotopic and diasterotopic atoms, group and faces, stereospecific and stereoslective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape, R/S Nomenclature, chiral centers and chiral molecules. Conformational analysis of cycloalkanes, disubstituted cyclohexanes, decalin, effect of conformation on reactivity.

UNIT – III

Aliphatic Nucleophilic Substitution

The SN2, SNI, mixed SN1', SN2', SNi and SET mechanisms, The neighbouring group mechanism, neighbouring group participation (anchimeric assistance) by oxygen, halogen and sulpher as a neighbouring group.

Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon, reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, ambident nucleophile and regioselectivity.

UNIT – IV

Aromatic Electrophilic Substitution

The arenium ion mechasism, orientation and reactivity, energy-profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling Vilsmeier-Haack reaction, Gatterman-Koch reaction.

Generation, structure, stability and reactivity of nucleophilic carbenes, carbanion (enolateion), nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangement.

UNIT – V

Aromatic Nucleophilic Substitution

The ArSN1, ArSN2 and benzyne mechanisms, Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.

CHE 103 PAPER -III PHYSICAL CHEMISTRY I (40 hrs)

UNIT – I

Partial Molar Properties, Nernst Heat Theorem (NHT) and Third Law of Thermodynamics

Partial molar properties, chemical potential, chemical potential and other thermodynamic functions, fugacity of real gases, Nernst heat theorem and its application to non-condensed systems, Statements of the third law of thermodynamics, Derivation of unattainability of absolute zero, The relationship between entropy constant and Nernst chemical constant, Determination of entropy from the third law using the correction due to gas imperfections.

UNIT – II

Statistical Mechanics

Quantum states and complexions, The combinatory rule, System with definite total energy, Degeneracy of energy levels, Probability and most probable distribution, Indistinguishability, Maxwell-Boltzmann statistics, partition function, Translational, rotational, vibrational, nuclear and electronic partition functions, Internal energy and heat capacity in terms of partition function.

UNIT – III

Spectroscopy

Molecular Spectra- Basic concepts of molecular spectroscopy, Classification of spectra, Characterization of electromagnetic radiations, Regions of the spectrum,

Rotation Spectra- Rigid and non-rigid rotation spectra-selection rule, Centrifugal distortion, Isotopic shift, Spectra of polyatomic molecules, Rotational constant, Experimental techniques.

UNIT – IV

Vibration rotation spectra- Simple harmonic oscillator, Vibrational energy, Anhormonicity, principle of vibration-rotation spectra, selection rule, PQR branches, Vibration in polyatomic molecules, Effect of nuclear spin, Isotopic shift, group frequency, Experimental techniques.

UNIT – V

Chemistry of Macromolecules

Introduction of type of polymers, Step polymerization, Kinetics of step polymerization, Polydispersion-average molecular weight concept, number, weight and viscocity average molecular weights, polydispersity and. molecular weight distribution Molecular weight averages, Method of determining the molecular weight by osmotic pressure, Light scattering, Sedimentation and Viscosity methods.

CHE 104 PAPER- IV ANALYTICAL TECHNIQUES (40 hrs)

Unit I

Errors in Quantitative Analysis: Accuracy, precision, sensitivity, specificity, standard deviation, classification of errors and their minimization, significant figures, Normal error curve.

Unit II

Analytical Spectroscopy: Principle, applications and limitations of spectrophotometery, Beer-Lambert law, analysis of mixtures, atomic absorption spectrometry (AAS).

Unit III

Voltammetry and Potentiometry

Principles, voltammograms, equation of voltammogram, different waveforms–linear scan, square scan and triangular scan, cyclic voltammetry. General principles, calomel electrodes, Ag/AgCl electrodes, membrane electrodes – ion selective electrodes, glass electrodes, liquid membrane electrodes.

Unit IV

Chromatography: Partition and distribution, principles of chromatography, plate and rate theory. retention time and retention factor, resolution and separation factor; general idea about adsorption, partition and column chromatography, paper and thin layer chromatography, gas chromatography (GC) and high performance liquid chromatography (HPLC)

UNIT- V

Thermo-analytical Methods

Thermal methods of analysis: Principles and instrumentations of TG and DTA. Complementary nature of TG and DTA. Differential scanning calorimeter (DSC).

CHE 105 Practical I Chemistry Practical-I

INORGANIC CHEMISTRY

Qualitative Analysis

Qualitative mixture analysis for seven radicals including two rare elements. (Mo, W, Ti, Zr, Th, Ce, V) in cationic and anionic forms.

Quantitative separation and determination of the following pairs of metal ions using gravimetric and volumetric methods

i. Ni^{2+} (gravimetrically) and Cu^{2+} (Volumetrically)
ii. Ba^{2+} (gravimetrically) and Cu^{2+} (Volumetrically)
iii. Fe^{3+} (gravimetrically) and Ca^{2+} (Volumetrically)
iv. Mg^{2+} (gravimetrically) and Ca^{2+} (Volumetrically)
v.

ORGANIC CHEMISTRY-I

A. Separation and identification of organic compounds using chemical methods from binary mixtures.
B. Estimation of glucose, aldehydes and ketones by chemical and spectroscopic methods.

PHYSICAL CHEMISTRY-I

1. Kinetic studies of a reaction between acetone and iodine catalysed by H^+ ions

2. Kinetics of oxidation of reducing sugars by potassium ferricyanide in presence of ammonium hydroxide or sodium hydroxide

3. Kinetics of oxidation of lactose/maltose by potassium ferricyanide in presence of sodium hydroxide.

4. Potentiometric titration of strong acid and strong base.

5. Determination of water hardness with EDTA

6. Determination of Rf value with help of paper chromatography

M.Sc. – Second Semester

CHE 201 PAPER –I INORGANIC CHEMISTRY II (40 hrs)

UNIT-I

Reaction Mechanism of Transition Metal Complexes

Inert and labile complexes, Stability Constant, Mechanism of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct indirect evidence in favor of conjugate mechanism.

UNIT-II

Anation reactions, reactions without metal ligand bond cleavage, Substitution reactions in square planer complexes, the trans effect, mechanism of the substitution reaction.

UNIT-III

Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT-IV

Term Symbols and Basic Principles of Electronic Spectroscopy

Frank – Condon principle, spin and Laporte selection rules, band intensities, band-width. Number of microstates and term symbols for gaseous atoms/ions. Spin-orbit coupling in spectroscopic ground state of p^2 and d^2 configurations and energies of J levels.

UNIT-V

Electronic Spectra of Transition Metal Complexes

Interpretation of electronic spectra using, Orgel and Tanabe – Sugano diagram for 3d transition metal complexes. Calculations of crystal field and ligand field parameters (Dq, B and ß parameters), nephelauxetic series and charge transfer spectra.

CHE 202 PAPER -II ORGANIC CHEMISTRY II (40 hrs)

UNIT-I

Free Radical Reactions

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes, Free radical rearrangement, Hunsdiecker reaction.

Addition to carbon-corbon Multiple Bonds

Mechanistic and stereochemical aspect of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity.Addition to cyclopropane ring. Hydroboration, Michael reaction, Sharpless asymmetric epoxidation, Stereochemistry of epoxidation and halolactonisation.

UNIT-II

Addition to Carbon-Hetero atom Multiple Bonds

Generation of enolate ions and their Synthetic applications. Stereochemistry of Witting reaction and Aldol condensation. Stobbe condensation reactions. Hydrolysis of esters.

Elimination Reactions

The E_2, E_1 and E_1cB mechanisms and their stereochemistry and orientation. Reactivity-effects of substrates, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination and Paterson elimination.

UNIT-III

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1,3,5-hexatriene and allyl system, Classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams, FMO and PMO approach, Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems.

UNIT-IV

Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolor cycloadditions and cheleoptropic rections

UNIT-V

Sigmatropic rearrangement

Suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, retention and inversion of configuration, (3,3) and (5,5) sigmatropic rearrangements, detailed treatment of Claisen and Cope-rearrangements. Fluxional tautomerism, Aza-Cope rearrangements. Introduction to Enereactins. Simple problems on pericyclic reactions.

CHE 203 PAPER -III PHYSICAL CHEMISTRY II (40 hrs)

UNIT-I

Quantum Chemistry : Origin of quantum theory, Black body radiation, Wien and Rayleigh-Jeans laws, Planck's law and energy of harmonic oscillator

Postulates of quantum mechanics, Three dimensional time independent Schrodinger wave equation, Eigen functions and eigen values, Normalization and orthogonality conditions, One dimensional harmonic oscillator, Tunnel effect, Eigen function and eigen value of H-atom (Solutions not required), Radial and Angular distribution curves for He-atom shapes of s, p, d and f- orbitals

Approximate Methods- Variation principle and its application to ground state H-atom,

UNIT-II

Chemical Kinetics: Thermodynamic formulation of rate constant, Comparison of collision and absolute reaction rate theories, Calculation of transmission coefficient, Transition State Theory in Solution, Primary and Secondary salt effects in the light of mechanistic tests, The theory of Absolute reaction rates - for reactions between atoms and reactions between molecules in terms of partition function, Influence of ionic strength and dielectric constant, Explosive reactions.

UNIT- III

Photochemical reactions: Absorption of light, chain reactions, free radical chains (Rice-Herzfield mechanism for the decomposition of ethane), Lambert's and Beer's law , Grotthus Draper law , Einstein's law of photochemical equivalence , Quantum efficiency , Reasons for low and high quantum yields , Kinetics of some typical photochemical reactions (decomposition of acetaldehyde , Dimerisation of anthracene etc.), Photoelectric cell , Photosenstization

UNIT-IV

Electrolytes

Limitation of Arrhenius theory of electrolytic dissociation, Role of solvent and inter-ionic forces, activities and activity coefficients, determination of activity coefficients, Debye-Huckel Theory of the structure of dilute ionic solution, charge density and electrical

potential, Properties of ionic cloud, activity coefficients from Debye-Huckel theory, Limiting law and its verification, Debye-Huckel Theory to more concentrated solutions, Partial molar quantities of electrolytic soltutions, determination of partial molar volume.

UNIT- V

Solid State

Crystal structures, Bragg's law and applications, Band structure of solid

CHE 204 PAPER- IV SPECTROSCOPIC METHODS (40 hrs)

UNIT -1

UV-Visible spectroscopy

UV-Visible spectroscopy: Basic principles, application of UV-Visible spectroscopy to organic structure elucidation, Woodward- Fisher rules

UNIT-II

IR and Raman Spectroscopy

IR-Spectroscopy: Basic Principles characteristic frequencies of common functional groups, application to organic and inorganic compounds**.** Basic Principles of Raman Spectroscopy and its application.

UNIT-III

NMR spectroscopy

Basic principles introduction to FT NMR techniques, Spectral parameters-Intensity, chemical shift, multiplicity, coupling constant, structure determination of organic compounds by ^{1}HNMR spectra and ^{13}C NMR Assignment of chemical shifts of common organic compounds and functional groups: Introduction to multinuclear NMR of common hetero atoms present in organic compounds .

UNIT-IV

Mass spectrometry

Basic principles, techniques of ion production and ion and daughter ions, molecular ion and isotope abundance, nitrogen rule energetics of fragmentation. Metastable ions, common fragmentation pathways-fragmentation of common chemical classes. Mc Lafferty rearrangement. Structural elucidation.

Applications of IR, NMR and Mass spectroscopy for structure elucidation of organic compounds

UNIT –V

ESR and Mossbauer spectroscopy

Electron spin resonance: g value, hyperfine structure, ESR of hydrogen atom, free radicals, ESR of solids, ESR of simple free radicals in solutions, Spin densities, spin polarisation, anisotropy of Zeeman and Hyperfine interactions.

Mossbauer Spectroscopy: Principles, isomer shift, quadrupole effect of magnetic field, applications to iron and tin compounds.

CHE 205 PAPER -V Practical-II

INORGANIC CHEMISTRY

- Preparation of Coordination Complexes and their Characterization by m.p, elemental Analysis and molar conductivity measurements.

i.	$VO(acac)_2$	vi.	$K_3[Fe(C_2O_4)_3]$
ii.	$K_3[Cr(C_2O_4)_3].\ 3H_2O$	vii.	$Hg[Co(SCN)_4]$
iii.	$Na[Cr(NH_3)_2\ (SCN)_4]$	viii.	$[Co(Py)_2Cl_2]$
iv.	$Mn(acac)_3$	ix.	$[Ni(NH)_6]Cl_2$

- Study of recorded UV-visible and IR of above prepared coordination compounds.

ORGANIC CHEMISTRY

(a) Preparation of various organic compounds involving two or three steps employing different reactions viz. Aldol Condensation, reactions of enolate ions, oxidation rections, Cannizzarro reaction, Molecular rearrangement reactions etc. with a view to give the student sufficient synthetic training in synthetic organic chemistry

(b) Isolation of :

a. Caffeine from tea leaves

b. Eugenol from cloves

PHYSICAL CHEMISTRY

1. Kinetics of oxidation of reducing sugars by Cu(II) in presence of ammonium hydroxide.

2. Kinetics of oxidation of cyclic ketones by alkaline hexacyanoferrate(III) catalysed by Rh(III) chloride.

3. Potentiometric titration of weak acid and strong base.

4. Kinetics of reaction between $K_2S_2O_8$ and KI.

M.Sc. – Third Semester

SPECILASITION IN INORGANIC CHEMISTRY

CHE 301 – PAPER-I- BIOINORGANIC CHEMISTRY (40 hrs)

UNIT-I

Role of Metal Ions in Biological Systems

Photosystems; nitrogen fixation, Na^+ / K^+ pump.

UNIT-II

Complexes of Biological Significance

Metal complexes of porphyrins and phthalocyanin, Vitamin B_{12} and B_6; chloropyhylls.

UNIT-III

Metallo Proteins

Function, Electronic structure, bonding and stereochemistry of the active site –

(1) Natural oxygen carring proteins – Haemoglobin, Myoglobin, Hemerythrins and Hemocyanin

(2) Electron Transport Protein – (a) Iron – sulfer Proteins – Rubredoxin and Ferrodoxins (b) Cytochromes (types a, b and c)

UNIT-IV

Metallo enzymes

Mo-containing Enzymes – Nitrogenase; Xanthine Oxidase, sulphite, Oxidase and Nitrate reductase (b) Iron-containing enzymes, cytochrome -c- oxidase, catalases, Peroxidases, cytochrome-p-450

UNIT-V

Copper – containing Enzymes – Superoxide dismutase (SOD), Bovine Superoxide dismutase (BOD), ascorbic acid oxidase and (b) Zinc – containg Enzymes carboxy – peptidase A and B; carbonic anhydrase and Urease.

CHE 302 PAPER - II- ORGANOMETALLIC CHEMISTRY (40 hrs)

UNIT-I

Classification of organometallic compounds based on hapticity and polarity of M-C bond; Nomenclature and general characteristics.

UNIT-II

Complexes of σ-Donar π -donor Organic Ligands

Transition metal alkenyls, alkynyls, carbenes and carbines. Preparation, bonding and structure of alkene, alkyne, allyl, dienyl and arene complexes, important reactions with special reference to nucleophilic and electrophilic attack on ligands and to organic synthesis.

UNIT-III

Transition Metal Compounds in Homogeneous Catalysis and compounds with M-H bond

Hydrogenation, hydroformylation and Zeigler-Natta polymerization of olefins.

UNIT-IV

Waker Process, hydrocarbanylation of olefins, oxopalladation reactions, activation of C-H bond. Metal hydrides (classical and non-classical).

UNIT-V

Fluxional Organometallic Compounds

Fluxionalloy and dynamic equilibria in compounds such as n^2 – olefins and n^3 – allyl and dienyl complexes.

CHE 303 PAPER – III - COORDINATION POLYMERS, CAGES, CLUSTERS AND NANOSTRUCTURES (40 hrs)

UNIT-I

Coordination Polymers

Classification, types of metal-organic frameworks (MOFs), Synthetic strategies, charactization, properties and applications.

UNIT-II

Metal Carbonyls and related Compounds

Preparation structure and properties; bonding in metal carbonyls, variants of CO bridging vibrational spectra of metal carbonyls, principle reaction types of metal carbonyls, metal nitrosyl.

UNIT-III

Polyhedral Boranes

Higher boranes, carboranes, metallo-boranes and metallo-carboranes – Structure and bonding in the light of Wade's and Jemmis' Rules.

UNIT-IV

Synthesis and applications of nanoparticles

Introduction of Nano Particles; its different methods for preparation; its applications to chemistry.

UNIT-V

Alkoxides Properties; structural aspects of various types of alkoxides – Industrial applications and catalytic aspects of metal alkoxides.

CHE 305 Practical-III

INORGANIC CHEMISTRY

Separation of a Mixture of Cations/Anions by Paper Chromatographic Technique Using Aqueous/Non-aqueous Media:

a. Pb^{2+} and Ag^{+} (aqueous and non-aqueous media)
b. Co^{2+} and Cu^{2+} (non aqueous media)
c. Cl^{-} and I^{-} (aqueous – acetone media)
d. Br^{-} and I^{-} (aqueous – acetone media)
e.

Ion-exchange Method of Separation

a. Separation of Zn^{2+} and Mg^{2+} on an anion exchanger
b. Separation of Co^{2+} and Ni^{2+} on an anion exchanger

SPECILASITION IN ORGANIC CHEMISTRY

CHE 301 PAPER- I- REARRANGEMENTS AND PHOTOCHEMISTRY (40 hrs)

UNIT-I

Molecular Rearrangements

Migration to electron deficient carbon atom

Pinacole-Pinacolone rearrangement, Wagner-Meerwein rearrangement, Tiffenev-Demjanov ring expansion, Dienone-Phenol rearrangement, Benzil Benzilic acid rearrangement, Favorski rearrangement.

UNIT-II

Migration to electron deficient nitrogen atom

Wolf, Hofmann, Curtius, Losen, Schmidt, Beckmann rearrangement.

Migration to electron deficient oxygen atom

Baeyer-Villiger rearrangement.

UNIT-III

Photochemistry of Carbonyl Compounds:

Photochemistry of enones, hydrogen abstraction.

UNIT-IV

Rearrangements of α, ß - unsaturated ketones and cyclohexadienones, photochemistry of p-benzoquniones.

UNIT-V

Photochemistry of unsaturated system

Olefins, cis-trans isomerisation, dimerisation, hydrogen abstraction and additions. Acetylenes-dimerisation, Dienes-photochemistry of 1, 3-butadiene (2+2) additions leading to cage structures, photochemistry of cyclohexadienes, Photochemistry of aromatic compounds-exited state of benzene and its 1,2 and 1, 3-shifts, Photo-Fries rearrangement,

Photo-Fries reaction of anilides, photosubstitution reaction of benzene derivatives, Photolysis of nitride esters and Barton reaction.

CHE 302 PAPER - II - OXIDATION, REDUCTION AND ORGANOMETALLIC REAGENTS (40 hrs)

UNIT-I

Oxidation

Hydrocarbons-alkenes, aromatic, rigns, saturated, C-H groups (actiuated and unactivated), alcohols, diols.

UNIT- II

Aldehydes, ketones and carboxylic acids, amines, hydrazines and sulphides.

Oxidations with ruthenium tetraoxide,iodobenzene diacetate and thallium (III) nitrate.

UNIT-III

Reduction

Hydrocarbons –alkenes, alkynes and aromatic rings.

Carbonyl Compounds: aldehydes, ketones, acids and their derivatives.

Epoxides reduction, Hydrogenolysis

UNIT-IV

Organometallic Reagents

Synthetic applications of organometallic compounds with mechanistic details of following metals.

Hg, Cd, Ce, Cu, Ni, Fe, Co, Rh, Cr and Ti

UNIT- V

Application of Pd(o) and Pd(II) complexes in organic synthesis – Stille, Suzuki and Sonogashira coupling, Heck reaction and Negishi coupling.

CHE 303- PAPER-III – STRATEGIES IN ORGANIC SYNTHESIS (40 hrs)

UNIT-I

Disconnection Approach

General introduction to synthons and Synthetic equivalents, Disconnections, (C-C, C-S, C-O, bonds).

UNIT-II

Functional group interconversion, chemoselectivity, cyclisation rection choosing synthetic route for small and large scale synthesis.

UNIT-III

Protecting Groups

Principle of protection of alcoholic, amino, carbonyl and carboxylic groups.

UNIT-IV

Stereochemistry in Organic Synthesis

Stereoselectivity and stereocpecificity. Regioselectivity and regiospecificity : Assymmetric synthesis- Sharpless asymmetric epoxidation.

UNIT-V

Synthetic Strategies :

(i) For formation of carbon-carbon bond.
(ii) For formation of carbon-nitrogen bond.

(iii) For formation of carbon-halogen bond.

(iv) For Ring Synthsis

(v) For Multistep Synthesis

CHE 305 PRACTICAL - ORGANIC CHEMISTRY

(a) Separation and identification of organic compounds using chemical methods from organic mixtures containing up to three components

(b) Preparation of organic compounds involving several stages

(c) Verification of Lambert Beer's Law using broriocresol green reagent.

(d) Estimation of carbohydrates, protein, aminoacids, ascorbic acid, blood cholesterol and aspirin in APC tablets by UV-visible Spectrophotometric method.

SPECIALISATION IN PHYSICAL CHEMISTRY

CHE 301 - PAPER – I – PHYSICAL CHEMISTRY (40 hrs)

UNIT-I

Distribution law (Barometric formula), Sedimentation equilibrium, Maxwell's law of distribution of velocity and energy, Maxwell's law and Gaussian density function, R,M,S, Mean and Most probable velocities, Collision frequency, Collision between like and unlike molecules, Triple collision.

UNIT-II

Viscosity, Thermal conductivity and Diffusion coefficient of gases (quantitative treatment), Mean free path. Mean and standard deviation absolute and relative errors, Linear regression, covariance and correlation coefficient.

UNIT-III

Indistinguishbility of gas molecules, Maxwell-Boltzmann law for gaseous system, Thermodynamic functions for gaseous systems, Molar heat capacity of gases, Heat capacity of hydrogen at low temperatures, Heat capacities of monoatomic crystals, The Einstein model, Debye's theory of solid, Heat capacities of crystals at very low temperatures.

UNIT-IV

Calorimetric entropy, Spectroscopic entropy , Comparison of calorimetric and Spectroscopic entropies, Third law of thermodynamics (i) Nernst Heat Theorem (ii) Entropy of chemical reactions (iii) statements of third law of thermodynamics and (iv) Conventional entropies, Expression of equilibrium constant in terms of partition functions, Equilibrium constants of simple system-(i) Ionization of metal atoms, (ii) Dissociation of diatomic molecules and (iii) Isotopic exchange equilibria.

UNIT-V

Calculation of thermodynamic properties from spectroscopic data, Bose-Einstein stastics, Fermi Dirac Statistics, Comparison of M-B, B-E and F-D statistics, Fermi-Dirac gas

(Electron gas in metals)- Bose —Einstein gas (liquid Helium).

CHE 302 - PAPER – II PHYSICAL CHEMISTRY (40 hrs)

UNIT-I

Magnetic susceptibility and its determination, susceptibility equivalents, Pascal's law and its applications, Diamagnetism of elements, Compounds and its ions, Langevin's theory of paramagnetism, Curie's law, Weiss molecular field theory of paramagnetism, Curie-Weiss law, Determination of Curie point.

UNIT-II

Orbital and spin moments, Electrons and multielectron systems, Magnetic property of complex compound in relation to their structure, Bohr magneton, L-S and J-J couplings. Electronoic spectra of molecules, Born-Oppenheimer approximation, Franck-Condon principle, Rotational fine structure of Electronic-Vibration transitions, Predissociation spectra, Molecular photoelectron spectroscopy (PES).

UNIT-III

Quantum theorty of Raman Spectra, Stokes and Antistokes lines, Rotation and vibration Raman spectra, Mutual exclusion principle, Laser Raman spectra, Theory of NMR relaxation process and chemical shift, The coupling constant, Nuclear spin interaction, Principle of ESR, Magnetic moment of electron and splitting factor, Hyper-fine splitting and double reasonance in ESR.

UNIT- IV

Mossbauer spectroscopy and its principle, Origin of line width, Isomer shift, Quadropole effects, Application of Raman, ESR, NMR and Massbaur spectra, C^{13} NMR spectroscopy, P^{31} NMR spectroscopy STM (Scanning Tunneling Microsocpy)-theory and application, AES (Auger Electron Spectroscopy), EELS (Electron Energy Lom Spectroscopy)

UNIT-V

Mechanism of electrode reactions, Overpotential, The current-potential relation, The Tafel equation, Hydrogen overvoltage and decomposition potential, Butler-Volmer equation, H_2-Evolution mechanism

CHE 303 - PAPER – III PHYSICAL CHEMISTRY (40 hrs)

UNIT-I

Kinetics of fast reactions: Techniques of study of fast reactions with reference to stop flow, T-Jump, Flash photolysis and relaxation phenomena.

UNIT- II

Thermodynamic functions for non-equilibrium states, Postulates and methodology, Linear laws, Gibbs equation, Entropy production and entropy flow, Phenamenological equations, Microscopic reversibility and Onsager's reciprocity relations.

UNIT-III

Transformations of the generalized fluxes and forces, Electrokinetic phenomena, Diffusion, Electric conduction, The stationary non-equilibrium states, States of minimum entropy production.

UNIT-IV

Nature of intermolecular forces, Various contributions of intermolecular forces, London theory of dispersion forces, Intermolecular potentials for polar and non-polar molecules, Potential parameters of L-J potential and evaluation of second virial coefficients.

UNIT-V

Partition function of imperfect gas and Virial equation of State, Critical constants and L-J parameter. Kinetics of oscillating reactions with special reference to Belousov-Zhabotinskii mechanism (B-Z mechanism).

LAB COURSE CODE CHE 305 PHYSICAL CHEMISTRY

1. Kinetics of Pd(II) catalysed oxidation of reducing sugars by N-bromoacetamide in acidic medium.

2. Kinetics of oxidation of ketones by Ce(IV) sulphate in acidic medium catalysed by Ir(III) chloride .

3. Conductometric titration of mixtures of acid and base.

4. Determination of freezing point depression constant.

CHE 304 PAPER IV ELECTIVE PAPER I

1. SOLID STATE AND NUCLEAR CHEMISTRY (40 hrs)

UNIT-I

Solid – State Chemistry I

Theory of metals free electron, valence bond and molecular orbital theories, conductors, insulators and Semiconductors. Superconductivity.

UNIT-II

Solid – State Chemistry II

Alloys and intermetallic compounds. Hume-Rothery Lattice defects in ionic crystals – stoichiometric and non-stoichiometric defects.

UNIT-III

Nuclear Energy I

Energy release in fission chain reactions, controlled release of fission energy use of moderators; Nuclear reactors including breeder reactors.

UNIT-IV

Nuclear Energy II

Energy release in fusion reactions; Principle of atom and hydrogen bombs. Nuclear Fuels-Fuel cycle & Fuel reprocessing.

UNIT- V

Radiochemical Analysis

Activation analysis, Radiometric and radio – release methods

2. BIOPHYSICAL CHEMISTRY (40 hrs)

Thermodynamics of Biochemical System

Different types of chemical process accounting in living systems, Relation between microscopic and macroscopic dissociation constants (acid dissociations of amino acids), Calculation of binding curves binding of protons by phosphate), Relationship between number of ligands bond per molecule of base and the partition function, Bioenergetic thermodynamics , Role of ATP in biological systems , Themodynamics of hydrolysis of adenosine triphosphate (ATP), Standard Gibbs free energies of a number of phosphate esters, Binding of oxygen by Myoglobin and hemoglobin,

Photochemistry and photobiology

Introduction, Photosynthesis , Chlorophyll molecules , Photosystems I and II, Biochemical reactions ,Vision , Rotation about C-C and C=C bonds , Mechanism of vision , Chemiluminescence and Bioluminescence , UV irradiation of DNA

Statistical mechanics in biopolymers

Chain configuration and conformations of macromolecules , Proteins , Polypeptide structure , Protein folding problems

3. ENVIRONMENTAL ANALYSIS / MONITORING (40 hrs)

UNIT-I

Water quality standards; Sampling and measurements of parameters like DO, BOD, COD, TOC, pH, Total Suspended Solids, Total Dissolved Solids, Hardness, Amount of Organic Matters, pE Determination of Inorganic ions, Plant Nutrients, NKP

UNIT-II

Methods of removal of Heavy Metals and Dyes from the polluted water

UNIT-III

Analysis of Waste Water- Monitoring of Soaps, Detergents and Pesticides in waste water, Sampling and Measurement of Air Pollutants, Monitoring automobile Emissions, Monitoring Emissions from Stationary Sources.

UNIT-IV

Monitoring Particulate Emissions (High – Volume sampling, Separation of Particles by size, XRF Spectrometry)

UNIT-V

Monitoring of Disease – Causing Agents, Microbiological tests for coliform, Multiple – Tube Fermentation Technique, Membrane Filtration Technique Ortho – nitrophenyl – β – D – galactopyranoside (ONPG) Test.

M.Sc. – Fourth Semester

SPECIALISATION IN INORGANIC CHEMISTRY

CHE 401 PAPER I - STRUCTURAL METHODS IN INORGANIC CHEMISTRY

(40 hrs)

UNIT- I

NMR Spectroscopy (i) : Use of Chemical shifts and spin-spin couplings for structural determination; Double resonance, and Dynamic processes in NMR; Decoupling phenomenon, Nuclear Overhauser Effect, DEPT spectra and structural applications in ^{13}CNMR; Use of Chemicals as NMR auxillary reagents (shift reagents and relaxation reagents); ^{1}H NMR of paramagnetic substances.

UNIT- II

Nuclear Spectroscopy – (ii) Multinuclear NMR of Metal nuclei. ^{31}P, ^{9}F, ^{27}Al, ^{11}B, ^{119}Sn, $^{203/205}$Tl, ^{51}V etc.

UNIT- III

Electron Spin Resonance Spectroscopy: Basic principle, Hyperfine Splitting (isotropic systems); the g value and the factors affecting thereof; interactions affecting electron energies in paramagnetic complexes (Zero-field splitting and Karamer's degeneracy); Electron-electron interactions, Anisotropic effects (the g value and the hyperfine couplings); Structural applications of transition metal complexes.

UNIT- IV

Infrared and Raman Spectroscopy: Basic Principle, Fundamental modes, Factors affecting vibrational frequency, Applications of vibrational spectroscopy in investigating (i) symmetry and shapes of simple AB2, AB3 and AB4 molecules on the basis of spectral data, (ii) mode of bonding of ambidentate ligands (thiocyanate, nitrate, sulphate and ureas).

UNIT- V

Mass Spectrometry: Basic Principle, Fragmentation pattern and Fingerprint applications in the interpretation of Mass spectra, effect of isotopes on the appearance of mass spectrum, recognition of the molecular ion peak; Ionization techniques (ESI, TOF and FAB)

CHE 402 PAPER II - STRUCTURAL METHODS IN INORGANIC CHEMISTRY

(40 hrs)

UNIT- I

Magnetic Proterties

Magnetic behaviours, recent methods of magnetic susceptibility measurements, anomalous magnetic properties of transition metal complexes, spin crossover phenomena, magnetic properties of binuclear metal complexes involving metal-metal exchange interaction (Bleaney-Bower equation).

UNIT- II

X-ray Photo electron Spectroscopy and Related Techniques

Basic principles, spectral features and their applications to structural determination of inorganic molecules and metal complexes: X-ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES).

UNIT- III

X-Ray Spectroscopy : X-ray Absorption Fine Structure Spectroscopy (EXAFS and XANE) with synchrotron radiations techniques and X-ray fluorescence (XRF).

UNIT- IV

UV Visible Spectroscopy: Theory and its applications to metal complexes

UNIT- V

Mossbauer Spectroscopy

Basic principle, conditions for Mossbauer spectroscopy, spectral parameters (Isomer shift, electric quadrupole interactions, magnetic interactions), temperature dependent effects,

structural deductions for iron and tin – complexes, miscellaneous applications. Nuclear Quadrupole Resonance (NQR) – Theory and its applications.

CHE 403 PAPER III - SELECTED TOPICS IN INORGANIC CHEMISTRY (40 hrs)

UNIT- I

(i) Electron Microscopy

SEM (Scanning electron microscopy), and TEM (Transmission electron microscopy).

UNIT- II

(ii) Electron Microscope AFM (Atomic force microscopy), STM (Surface tunneling microscopy).

UNIT- III

Photochemistry of Transition Metal complexes: Photoreactions of inorganic complexes.

UNIT- IV

Electrochemical Methods: Cyclic voltammetry.

UNIT- V

Differential pulse voltammetry, anodic stripping voltammetry, chronoamperometry, coulometry.

LAB COURSE CODE CHE 405 INORGANIC

1. Spectroscopic Determinations

a) Mn/Cr/V in steel Sample.
b) Ni/Mo/W/V/U/ by extractive spectrophotometric method.
c) Fluoride/ nitrite / Phosphate.
d) Iron – phenanthroline complex: Job's method.
e) Zirconium – Alizarin Red-S complexes: Mole-ratio method.
f) Copper-Ethylene diamine complexes: Slope-ratio method.
g) Iron-thiocyanate complex-Ionophoretic method

2. Determination of crystal system and plane of some alkali halide by X-ray techniques

SPECIALISATION IN ORGANIC CHEMISTRY

CHE 401 PAPER I- BIOSYNTHESIS AND CHEMISTRY OF NATURAL PRODUCTS (40 hrs)

UNIT- I

Bio-synthesis of Natural Products

a. The acetate hypothesis, poly β-Ketoacids, Biosynthesis, Biogenesis Primary and Secondary reactions involved in biosynthesis. Biosynthesis of poly-ß-ketoacid
b. Isoprene rule, mevalonic acid from acetyl Co-enzyme A. Biosynthesis of mono, sesqui,di and triterpenes.
c. Shikimic acid pathway for biosynthesis of aromatic ring.
d. General biosynthesis of alkaloids.

UNIT- II

Terpenoids and Carotenoids

Classification, isoprene rule. Structure determination, stereochemistry, synthesis of the following representative molecules: citral, α terpenol, farnesol, santonin, abietic acid and ß-carotene, menthol. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible.

UNIT- III

Alkaloids

General methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, Structure, stereochemistry and synthesis of the following : Ephedrine, (+) nicotine, quinine and morphine. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible.

UNIT- IV

Steroids : Basic skeleton Diel's hyadrocarbon and stereochemistry, structure determination and synthesis of cholesterol, testosterone, estrone and progesterone. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible.

UNIT- V

Prostaglandins: Occurrence, nomenclature, classification. Synthesis of PGE_2 and PGF_{2a}

Plant Pigments: General methods of structure determination, synthesis of Apigenin, Quercetin Cyanidin Hirsutin. Quercetin-3 glucoside, Diazein and cyanidine-7 glucoside. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible.

CHE 402 PAPER II - HETEROCYCLES AND VITAMINS (40 hrs)

The Chemistry of the following ring systems: Synthesis and reactions including some given aspects.

UNIT- I

Three – membered rings ----- Aziridines

Four-membered rings ----- Azetidines and their 2-oxo derivatives

Condensed pyrroles ------ Indoles

UNIT- II

Five-membered rings containing two heteroatoms:

I. Oxazoles --- Reaction as dienes, Cornforth rearrangement, Reaction with singlet oxygen.
II. Isoxzoles ---- Boulton-Katritzky rearrangement, photoisomerizations.
III. Pyrazoles ---- Rearrangement to imidazoles
IV. Imidazoles ----- Acidity of C-2 hydrogen, Catalyst for ester hydrolysis
V. Thiazoles --- Thiazolium ylide as catalyst.
VI.

UNIT- III

Six-membered – Pyrimidines – ANRORC mechanism in nucleophilic Substitution

UNIT- IV

Vitamins I : Structure determination including synthesis of

1. Thiamine (Vitamin B1)
2. Pyridoxine (Vitamin B6)

UNIT- V

Vitamins II : Structure determination including synthesis of

1. Biotin (Vitmin H)
2. Vitamin E
3.

CHE 403 PAPER III – BIOMOLECULES (40 hrs)

UNIT- I

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Fisher's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetic, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition, regulatory enzymes, Enzyme immobilization.

UNIT- II

Nucleic Acids

Secondary and Tertiary structure of DNA/RNA and stabilizing forces, polymorphic nature of DNA, Sequencing, solid phase synthesis; trimester, phosphoramidite and phosphonate methods, Purification : HPLC and gel electrophoresis. Peptide nucleic acid (PNA).

UNIT- III

Lipids

Chemistry and synthesis of phospholipids and glycolipids of lipid aggregates, micelles, bi-layers and biological membrane

UNIT- IV

Antibiotics

Synthesis of penicillin G, chloramphenicol, cephalosporin, tetracycline and streptomycin

UNIT- V

Pyrethroids and Rotenones, Pheromones

Synthesis and reactions of Pyrethroids and Rotenones.

(For structure elucidation, emphasis is to be placed on the use of parameters wherever possible)

LAB COURSE CODE CHE 405 (IV) ORGANIC

a) Estimation of $-NO_2$ group in organic compounds.
b) Isolation of casein from milk, piperine from black papper and nicotine from tobacco.
c) Applications of NMR spectrocopy (^1H & ^{13}C), UV, IR and Mass Spectroscopy in structure determination of organic and biologically important compounds

SPECIALISATION IN PHYSICAL CHEMISTRY

CHE 401 PAPER I – PHYSICAL I (40 hrs)

UNIT- I

Ideal and non-ideal solutions, Inter-connection between Raoult's law and Henry's Law, Determination of Partial Molar Properties, Thermodynamic functions of mixing of non-ideal solutions, Excess thermodynamic functions.

UNIT- II

Gibbs-Duhem-Margules equation and its applications, Activity and activity coefficients, Activity coefficients from excess thermodynamic functions,

The theory of Van Laar, Scatchard Hildebrand theory, Wilson model and Flory-Huggins theory.

UNIT- III

Concept of operators in quantum mechanics—operators for velocity, kinetic energy, momentum and angular momentum, Detivation of Heisenberg's uncertainty principle, Solution for Hydrogen atom, Born-Oppenheimer approximation, Valence bond theory and its application to homonuclear (Hydrogen) and heteronuclear (HCl) diatomics, LCAO-MO treatment of hydrogen molecule ion, Comparative study of MO and VB theory.

UNIT- IV

Huckel molecular orbital theory and its application to hybridization systems (ethylene, butadiene, allyls and benzene), Calculation of delocalization energy, Physical significance of charge density and bond order, Calculation of bond length, Pauling and Wheland's modification in HMO theory and it application to heteromolecules (pyrimidine), Perturbation

methods in LCAO-MO theory, Extended Huckel molecular orbital theory and SCF-MO method,

UNIT- V

Stability and properties of colloids, Isotherms and surface area , Heterogeneous catalysis.

CHE 402 PAPER II –PHYSICAL CHEMISTRY (40 hrs)

UNIT- I

Classification of solids, Bonding in solids, covalent, metallic, ionic and molecular crystals, Lattice energy of crystals, Cohesive energy, Conduction in solids and superconductance, Electronic structures of solids, Free electron theory, Fermi-gas theory and band theory of solids, Metals, semi-conductors and insulators, Intrinsic extrtinsic p-tyipe and n-type semi-conductors,

UNIT- II

Vapour pressure, compressbility viscosity and sound velocity, Internal pressure and its determination, Significance of internal pressure, solubility parameter and cohesive-energy-density, Free volume of liquids and its determination, Application of free volume and its relation with energy and heat of vaporization.

UNIT- III

Partition function of a liquid, Equation of state in terms of partition function, Outline of the theory of liquid state:JSimple cell theory (Eyring equation) and cell model theory of Lennard-Jones and Devonshire, Eyring's free volume theory of liquid viscosity, Effect of pressure on viscosity,

Thermodynamic functions of ideal and non-ideal liquid mixtures, Partial molar properties of liquid mixtures, Determination of partial molar volume and partial molar enthalpy,

UNIT- IV

The triumph and limitations of Debye-Huckel theory of activity coefficients, Electrical potential and mean activity coefficient in the case of ionic clouds with finite sized ions, The ion size parameter and comparison of the finite-ion-size model with experiment,

Asymmetry and electriphoretic effects, Stoke's law and Walden product, Debye-Huckel-Onsager equation, Conductance ratio and the Onsager slope, Verification of Debye-Huckel-Onsager equation, Conductivity of weak electrolytes and conductance in nonaqueous

solvents, Modifications of Debye-Huckel-Onsager equation, Fuoss-Onsager and other equations, Wien and Debye-Fakenhagen effects.

UNIT- V

Viscosity of electrolyte solutions-Jones-Dole equation and significance of A and B coefficients, Ion association in an electrolyte solution, Formation of pairs, triplets etc, The probability of finding oppositely charged ions near each other, Bjerrum theory of ion association,

CHE 403 PAPER III – PHYSICAL CHEMISTRY (40 hrs)

UNIT- I

Kinetics and mechanism of reactions on surface, Mechanism of surface reactions, Uni and bi-molecular surface reactions, Langmuir-Hinshelwood mechanism, Langmuir-Rideal mechanism, Inhibition of surface reactions, Absolute reaction rate theory of surface reactions.

UNIT- II

Comparisoon of homogeneous and heterogenous reactions, Study of equilibrium constant and steady state treatment for Arrhenius and Vant Hoff's complexes, Influence of substituents on reaction rates (inductive and electromeric effects), Linear free energy relation ship, Taft equation, compensation effect, Hemmett acidity tunetions.

UNIT- III

a) Oxidation of sugars by $K_3Fe(CN)_6$ and Cu^{+2} in alkaline medium,

(b) Oxidation of organic molecules by $K_3Fe(CN)_6$ and Ce (IV),

UNIT- IV

Kinetic of initiation retardation, chain polymerization and ionic polymerization (anionic and cationic), Copolymerisation (with special reference to monomer reactivites ratios).

UNIT- V

Coordination polymerization, Degradation of polymers (oxidative, chemical and photolytic), An introduction to conducting polymers, Polyelectrolytesn oxidation of organic substrates by $K_3[Fe(CN)_6]$ and Ce(IV) in alkaline / acidic medium.

LAB COURSE CODE CHE 405 PHYSICAL CHEMISRTY

1. Kinetics of Ir(III) catalysed oxidation of reducing sugars by sodium periodate in alkaline medium.

2. Kinetics of oxidation of reducing sugars by potassium iodate in alkaline medium using Ir(III) chloride as homogeneous catalyst.

3. Kinetics of Ru(III) catalysed oxidation of organic substrates by Ce(IV) sulphate in acidic medium .

4. Kinetics and mechanism of Ru(III) catalysed oxidation of reducing sugars by N-bromoacetamide in acidic medium .

SEMESTER IV - PROJECT WORK

Course Code: CHE 406 (Inorganic/Organic/Physical)

CHE 404 PAPER IV ELECTIVE PAPER

1. ENVIORNMENTAL CHEMISTRY (40 hrs)

UNIT: I

Introduction to Enviornmental Chemistry

Concept and scope of environmental chemistry, Enviornmental terminology and nomenclatures, Environmental segments.

UNIT: II

The natural cycles of environment (Hydrological, oxygen, Nitrogen)

UNIT: III

Chemical Toxicology

Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides.

UNIT: IV

Air Pollution

Particulates, Aerosols, SOx, NOx, COx and hydrocarbon, Photochemical smog, Air-quality standards.

UNIT: V

Water Pollution

Water-quality parameters and standards: physical and chemical parameters, Dissolved oxygen, BOD, COD, Total organic carbon, Total nitrogen, Total sulfur, Total phosphorus and chlorine, chemical separation (Pb, As, Hg)

2. REAGENTS AND REACTIONS (40 hrs)

UNIT: I

Regents in Organic Synthesis I

Use of following reagents in organic synthesis and functional group transformation (including stereochemistry where possible) Complex metal hydrides – $NaBH_4$, $LiAlH_4$, DIBAL, diborane, diisoamylborne, thexylborane, 9-BBN, isopinocamphenyl and diisopino-campherylborame, catechoborane; Gilman's reagent; Lithium disopropyl amide (LDA)

UNIT: II

Regents in Organic Synthesis II

Use of following reagents in organic synthesis and functional group transformation (including stereochemistry where possible): Dicyclohexylcarbcarbodimide (DCC); 1, 3-Dithiane (Reactivity Umpolung); Trimethylsily iodide; Tri n-butyltin hydride; DEAD

UNIT: III

Regents in Organic Synthesis III

Use of following regents in organic synthesis and function group transformation (including stereochemistry where possible) : DDQ; Hydrazine and phenylhydrazine; Nucleophilic heterocyclic carbenes (NHC); Nitrogen, Sulphur and Phosphorus Ylide: Preparation and their synthetic applications.

UNIT: IV

Name reactions

Selective Organic name reaction and their Synthetic Application

Stork Enamine reaction; Ene Reaction; Barton Reaction; Hofmann-Loffler-Freytag Reaction; Shapiro Reaction

UNIT: V

Green Chemistry

Introduction of green chemistry basic principles of green chemistry, organic synthesis using visible light, ionic liquid and PEGs.

Selective Organic name reaction and their Synthetic Application

Baylis-Hillman Reaction, Stetter Reaction

3. NUCLEAR CHEMISTRY AND RADIOCHEMICAL ANALYSIS (40 hrs)

UNIT - I

Fundamentals of Nuclear Chemistry, Stability of nucleus, Properties of nucleus, Nuclear Models.

UNIT - II

Nuclear reactions – fission, fusion, spallation, fragmentation, stripping and pick up reactions, photonuclear and thermonuclear reactions.

UNIT - III

Interaction of Radiation with matters: Counting techniques and counting statistics, Ionisation, Propertional GM and scintillation counters, counting errors and corrections, Chemical Dosimetry.

UNIT - IV

Activation Analysis Tracer Techniques and Dilution Analysis, Radiometric titrations.

UNIT - V

Radiocarbon and other dating