Teaching Plan
Department of Chemistry
Session 2022-23
Even Semester

**Term I: From commencement of class to 1st Internal Assessment**

**Term II: 1st Internal Assessment to 2nd Internal Assessment**

**Term III : 2nd Internal Assessment to end semester exam**

# Teaching plan : 2022-23 (Even Semester)
# Dr. Gagan Chandra Mandal
# Dept. of Chemistry

| Semester II | | |
|---|---|---|
| **Syllabus allotted** | **C3T:** Extra nuclear Structure of atom | |
| | C3P: CHEMISTRY (LAB | |
| **C3T:** Extra nuclear Structure of atom | Lec No | |
| | **Term I** | |
| | **01** | Course out come and Introduction to Atomic structure |
| | **02** | Bohr's theory, its limitations |
| | **03** | Atomic spectrum of hydrogen atom, Sommerfeld's Theory. |
| | **04** | Wave mechanics: de Broglie equation |
| | **05** | Heisenberg's Uncertainty Principle and its significance |
| | **06** | Mathematica problems |
| | **07** | Schrödinger's wave equation, significance of ψ and ψ2 |
| | **08** | Quantum numbers and their significance |
| | **Term II** | |
| | **09** | Radial and angular wave functions for hydrogen atom. |
| | **10** | Radial and angular distribution curves. Shapes of s, p, d and f orbitals |
| | **11** | Pauli's Exclusion Principle, Hund's rules and multiplicity |
| | **12** | Exchange energy, Aufbau principle and its limitations |
| | **Term III** | |
| | **13** | Ground state Term symbols and their implications |
| | **14** | Ground state Term symbols of different atoms and ions |
| | **15** | Problem solving |
| | **16** | Problem solving |
| C3P: CHEMISTRY (LAB ) Acid and Base Titrations& Oxidation-Reduction Titrimetric | **Lab** | |
| | **Term I** | |
| | **01** | Estimation of carbonate and hydroxide present together in mixture |
| | **02** | Estimation of carbonate and bicarbonate present together in a mixture. |
| | **03** | Estimation of free alkali present in soaps |
| | **04** | Estimation of free alkali present in detergents |
| | **Term II** | |
| | **05** | Estimation of Fe(II) using standardized KMnO4 solution |
| | **06** | Estimation of oxalic acid and sodium oxalate in a given mixture |
| | **07** | Estimation of Fe(II) and Fe(III) in a given mixture using K2Cr2O7 solution |
| | **08** | Estimation of Fe(III) and Mn(II) using standardized KMnO4 solution |
| | **09** | Estimation of Fe(III) and Cu(II) in a mixture using K2Cr2O7 |
| | **Term III** | |
| | **10** | Estimation of Fe(III) and Cr(III) in a mixture using K2Cr2O7 |
| | **11** | Practice |
| | **12** | Practice |
| | **13** | Practice |
| | **14** | Practice |
| | **15** | Practice |
| **Semester IV** | | |
| **Syllabus Allotted** | **Lec No** | **C9T: Inorganic Chemistry-III- Metallurgy** |

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|---|---|---|
| | **Term I** | |
| | **01** | Introduction to metallurgy |
| | **02** | General Principles of Metallurgy |
| | **03** | Chief modes of occurrence of metals based on standard electrode potentials |
| | **04** | Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. |
| | **05** | Electrolytic Reduction |
| | **06** | Hydrometallurgy with examples |
| | **Term II** | |
| | **07** | Different methods of purification of metals |
| | **08** | Metal purification through electrolytic Kroll process |
| | **09** | Parting process |
| | **10** | Van Arkel-de Boer process |
| | **Term III** | |
| | **11** | Mond's process |
| | **12** | Zone refining |
| | **13** | Problem solving |
| | **14** | Problem discussion |
| **Semester VI** | | |
| **Syllabus Allotted** | CI3T: INORGANIC CHEMISTRY V- Reaction Kinetics and Mechanism | |
| | **Term I** | |
| | **01** | Reaction mechanism and its importance |
| | **02** | Introduction to inorganic reaction mechanisms |
| | **03** | Substitution reactions in square planar complexes |
| | **04** | Trans- effect& application of Trans effect in complex synthesis |
| | **05** | Theories of trans effect |
| | **06** | Mechanism of nucleophilic substitution |
| | **07** | Square planar complexes |
| | **Term II** | |
| | **08** | Thermodynamic and Kinetic stability, |
| | **09** | Kinetics of octahedral substitution |
| | **10** | Specific examples and case study |
| | **11** | Ligand field effects and reaction rates, |
| | **Term III** | |
| | **12** | Mechanism of substitution in octahedral complexes. |
| | **13** | Assignments |
| | **14** | Problem solving and discussion |
| | **15** | Problem solving and discussion |

Teaching Plan: 2022-23 (Even semester)

PRASANNA KUMAR DULEY

Department of Chemistry

| Semester IV | | |
|---|---|---|
| **Syllabus Allotted** | C8T: PHYSICAL CHEMISTRY-III:a) Application of Thermodynamics – II<br>b) Electrical Properties of molecules,C) Quantum Chemistry<br>C8P:Practical :<br>Experiment 1: Determination of solubility of sparingly soluble salt in water, in electrolyte with common ions and in neutral electrolyte (using common indicator)<br>Experiment 2: Potentiometric titration of Mohr's salt solution against standard K2Cr2O7 solution<br>Experiment 3: Determination of Ksp for AgCl by potentiometric titration of AgNO3 solution against standard KCl solution<br>Experiment 4: Effect of ionic strength on the rate of Persulphate – Iodide reaction<br>Experiment 5: Study of phenol-water phase diagram<br>Experiment 6: pH-metric titration of acid (mono- and di-basic) against strong base<br>GE4T :, Phase Eequilibria,Electrochemistry<br>GE4T: Practical: | |
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| **CC-08 T** | **Lec No** | **Topics to be coveredC8T: PHYSICAL CHEMISTRY-III:a) Application of Thermodynamics – II<br>b) Electrical Properties of molecules,C) Quantum Chemistry** |
| | **Term I** | |
| | **01** | Colligative properties: Vapour pressure of solution; Ideal solutions, ideally diluted solutions and colligative properties; Raoult's law; |
| | **02** | Thermodynamic derivation using chemical potential to<br>derive colligative properties (i) relative lowering of vapour pressure,<br>(ii) elevation of boiling point, |
| | **03** | Thermodynamic derivation for(iii) Depression of freezing point, (iv) Osmotic pressure |
| | **04** | Applications in calculating molar masses of normal, dissociated and associated solutes in solution; Abnormal colligative properties |
| | **05** | Phase rule: Definitions of phase, component and degrees of freedom; Phase rule and its Derivations. |
| | **06** | Definition of phase diagram; Phase diagram for water, CO2, Sulphur<br>First order phase transition and Clapeyron equation; Clausius-Clapeyron equation - derivation |
| | **07** | Liquid vapour equilibrium for two component systems; Phenol-water system.Three component systems, water-chloroform-acetic acid system, triangular plots |
| | **Term II** | |
| | **08** | Duhem-Margules equation; Henry's law; Konowaloff's rule; Positive and negative deviations from ideal behavior; Azeotropic solution; Liquid-liquid phase diagram using phenolwater system; Solid-liquid phase diagram; Eutectic mixture |
| | **09** | Dipole moment and polarizability: Polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation (both without derivation) and their application; Determination of dipole<br>moments |
| | **10** | C) Quantum Chemistry<br>Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component |
| | **11** | Rigid rotator model of rotation of diatomic molecule; Schrödinger equation, transformation to spherical polar coordinates; Separation of variables. Spherical harmonics; Discussion of solution |

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| | **12** | Qualitative treatment of hydrogen atom and hydrogen-like ions: Setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression) |
| | **13** | Average and most probable distances of electron from nucleus; Setting up of Schrödinger equation for many-electron atoms (He, Li) |
| | **Term III** | |
| | **14** | LCAO and HF-SCF: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H2+; Bonding and antibonding orbitals |
| | **15** | Qualitative extension to H2; Comparison of LCAO-MO and VB treatments of H2 and their limitations |
| | **16** | Hartree-Fock method sdevelopment, SCF and configuration interaction (only basics) |
| **GE4T**<br><br>GE4T&GE4P | **Term I** | |
| | **01** | Phase Equilibria :Phases, components and degrees of freedom of a system, criteria of phase equilibrium; Gibbs Phase Rule and its thermodynamic derivation; Derivation of Clausius – Clapeyron equation and its importance in phase equilibria |
| | **02** | Phase diagrams of one-component systems (water and sulphur) |
| | **03** | two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K) |
| | **04** | Conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes |
| | **05** | ; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometrictitrations (acid-base) Transport Number and principles of Hittorf's and Moving-boundary method |
| | **06** | Electromotive force Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible and irreversible cells with examples |
| | **07** | Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential; Electrochemical series; Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data |
| | **Term II** | |
| | **08** | Concentration cells with and without transference, liquid junction potential |
| | **09** | pH determination using hydrogen electrode and quinhydrone; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation) |
| | **10** | Study of the equilibrium of one of the following reactions by the Distribution method:<br>I2(aq) + I-(aq) = I3-(aq)Cu2+(aq) + xNH2(aq) = [Cu(NH3)x]2 |
| | **11** | a) Determination of dissociation constant of a weak acid (cell constant, equivalent conductance are also determined) |
| | **12** | b) Perform the following conductometric titrations: (Any one)<br>(i) Strong acid vs. strong base<br>(ii) Weak acid vs. strong base |
| | **13** | potentiometric titrations:<br>(i) Weak acid vs. strong base |
| | **Term III** | |
| | **14** | potentiometric titrations:ii) Potassium dichromate vs. Mohr's sal |
| | **15** | Problem solving |
| | **16** | Problem solving |
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| Semester VI | | |
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| **Syllabus Allotted** | C14T:Photochemistry&Surface phenomenon<br>C14P : LAB:Practical<br>Experiment 1: Determination of surface tension of a liquid using Stalagmometer<br>Experiment 2: Determination of CMC from surface tension measurements<br>Experiment 3: Verification of Beer and Lambert's Law for KMnO4 and K2Cr2O7 solution<br>Experiment 4: Study of kinetics of K2S2O8 + KI reaction, spectrophotometrically<br>Experiment 5: Determination of pH of unknown buffer, spectrophotometrically<br>Experiment 6: Spectrophotometric determination of CMCsical Chemistry-V: | |
| **C14T** | **Lec no** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Lambert-Beer's law: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients |
| | **02** | Laws of photochemistry, Stark-Einstein law of photochemical equivalence& quantum yield |
| | **03** | actinometry, examples of low and high quantum yields<br>Photochemical Processes: Potential energy curves (diatomic molecules), Frank-Condon principle |
| | **04** | vibrational structure of electronic spectra; Bond dissociation and principle of determination of dissociation energy (ground state); Decay of excited states by radiative and non-radiative paths; Pre-dissociation |
| | **05** | Fluorescence and phosphorescence, Jablonskii diagram |
| | **06** | Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photostationary state; HI decomposition |
| | **07** | H2-Br2 reaction, dimerisation of anthracene; photosensitised reactions, quenching; Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence. |
| | **08** | Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; Work of cohesion and adhesion, spreading of liquid over other surface; Vapour pressure over curved surface; Temperature dependence of surface tension |
| | **Term II** | |
| | **09** | Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required) |
| | **10** | Gibbs adsorption isotherm<br>and surface excess; Heterogenous catalysis (single reactant) |
| | **11** | Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea) |
| | **12** | Tyndall effect; Electrokinetic phenomena (qualitative idea only); Determination of Avogadro number by Perrin's method; Stability of colloids and zeta potential; Micelle formation |
| | **Term III** | |
| | **13** | Problem & solution |
| | **14** | Problem & solution |
| | **15** | Problem & solution |
| | **Lab** | |
| **C14P** | **Term I** | |
| | **01** | Experiment 1: Determination of surface tension of a liquid using Stalagmometer |
| | **02** | Experiment 2: Determination of CMC from surface tension measurements |
| | **03** | Experiment 3: Verification of Beer and Lambert's Law for KMnO4 and K2Cr2O7 solution |
| | **04** | Experiment 4: Study of kinetics of K2S2O8 + KI reaction, spectrophotometrically |

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| | **05** | Experiment 5: Determination of pH of unknown buffer, spectrophotometrically |
| | **Term II** | |
| | **06** | Experiment 6: Spectrophotometric determination of CMC |
| | **07** | PRACTICAL REVISION |
| | **08** | PRACTICAL REVISION |
| | **09** | PRACTICAL REVISION |
| | **Term III** | |
| | **10** | PRACTICAL REVISION |
| | **11** | PRACTICAL REVISION |
| | **12** | PRACTICAL REVISION |

# Teaching Plan - 2022-23 (Even semester)

DR. INDRANIL CHAKRABORTY
Department of Chemistry

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| **Semester II** | | |
| **Syllabus allotted** | C4T: ORGANIC CHEMISTRY-II (Theory)Stereochemistry<br>C4T: ORGANIC CHEMISTRY-II (Practical) | |
| **C4T** | **Lec No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome and different types of chirality |
| | **02** | Chirality arising out of stereoaxis, axial chirality with examples |
| | **03** | stereoisomerism of substituted cumulenes with even and odd number of double bonds; chiral axis in allenes, spiro compounds |
| | **04** | Stereoisomerism ofalkylidenecycloalkanes and biphenyls |
| | **05** | Configurational descriptors (Ra/Sa and P/M). Atropisomerism |
| | **06** | Racemisation of chiral biphenyls; buttressing effect. Concept of prostereoisomerism: prostereogenic centre |
| | **07** | Concept of (pro) n -chirality: topicity of ligands and faces, with examples and symmetry criteria |
| | **Term II** | |
| | **08** | Elementary idea about pro-R/pro-S, pro-E/pro-Z |
| | **09** | Re/Si descriptorsof ligands on propseudoasymmetric centre |
| | **10** | Dihedral angle, torsion angle and their difference |
| | **11** | Conformation: conformational nomenclature: eclipsed, staggered, gauche, syn and anti |
| | **12** | Klyne-Prelog terminology; P/M descriptors |
| | **13** | Energy barrier of rotation, concept of torsional and steric strains |
| | **Term III** | |
| | **14** | Relative stability of conformers on the basis of steric effect, dipole-dipole interaction and H-bonding, butane gauche interaction |
| | **15** | Problem discussion |
| | **16** | Problem discussion |
| **Semester IV** | | |
| **Syllabus Allotted** | CC-10 T : ORGANIC CHEMISTRY-IV Organic spectroscopy (Theory)<br>CC 10 P :ORGANIC CHEMISTRY-IV Quantitative Estimations (Prac)<br>SEC 2T : BASIC ANALYTICAL CHEMISTRY (Theory)<br>SEC 2T: BASIC ANALYTICAL CHEMISTRY (Prac) | |
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| | **Lec No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome of CC 10 T & P, Basics of Organic Spectroscopy |
| | **02** | Introduction to UV Spectroscopy, types, of transitions. **C**hromophores and auxochromes; Wavelength &intensity of absorptions |
| | **03** | Application of Woodward's Rules for calculation of λ max for conjugated diene, α,β unsaturated aldehydes and ketones. |

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| **CC-10 T** | **04** | Steric effect, solvent effect, effect of pH;:Different systems etc. |
| | **05** | Assignments & Problem discussion |
| | **06** | Introduction to IR Spectroscopy, Modes of molecular vibrations |
| | **07** | IR active molecules; application of Hooke's law, force constant, fingerprint region ,overtone bands; vibrational couplings etc. |
| | **Term II** | |
| | **08** | Characteristic and diagnostic stretching frequencies of C-H, N-H, O-H, C-O, C-N, C-X, C=C ,C=O, C=N, N=O, C≡C, C≡N |
| | **09** | Class Assignment & discussion of problems |
| | **10** | Introduction to NMR Spectroscopy, basic principles of Proton Magnetic Resonance; equivalent and non-equivalent protons |
| | **11** | Chemical shift and factors influencing it, Spin coupling and coupling constant (1st order spectra) |
| | **12** | Pascal's triangle;non-first-order splitting with examples |
| | **Term III** | |
| | **13** | NMR peak area, integration; coupling patterns of common organic compounds |
| | **14** | Interpretation of NMR spectra of organic compounds |
| | **15** | Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules. |
| | **16** | Assignments and problem discussion |
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| **SEC 2 T** | **Term I** | |
| | **01** | Course outcome and general importance of Basic Analytical Chemistry |
| | **02** | Composition of Soil and its different types |
| | **03** | pH of soil, and necessity to maintain soil pH |
| | **04** | Nutrient content and pH |
| | **05** | pH measurement using Complexometric titrations, Chelation, Chelating agents, use of indicators |
| | **06** | Assignment and discussion |
| | **07** | Water: Source, type and possible pollutants |
| | **Term II** | |
| | **08** | Importance of water analysis |
| | **09** | Different kinds of water purification process |
| | **10** | Analysis of water |
| | **11** | Definition of pure water water sampling methods |
| | **12** | sources responsible for contaminating water, |
| | **Term III** | |
| | **13** | water purification methods |
| | **14** | BOD & COD and the process of determination |
| | **15** | Problem solving |
| | **16** | Problem solving |
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| **Semester VI** | | |

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| **Syllabus Allotted** | DSE3T: Green Chemistry (Theory)<br>DSE4T: Polymer Chemistry (Theory)<br>DSE4P: Polymer Chemistry (Practical) | |
| | **Lecture** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome, and Importance of Polymer in todays life |
| | **02** | Introduction and history of development of polymeric materials |
| | **03** | Different schemes of classification of polymers with example and structure, Pending group. |
| | **04** | Polymer nomenclature, Degree of polymerisation |
| | **05** | Molecular forces and chemical bonding in polymers, |
| | **06** | Texture of Polymers. Functionality and its importance: Criteria for synthetic polymer formation, |
| | **Term II** | |
| **DSE 4 T** | **07** | Classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. |
| | **08** | Bifunctional systems, Poly-functional systems |
| | **09** | Molecular weight distribution in polymers, Different types of molecular weight in polymers (Mn, Mw, etc) |
| | **10** | Determination of (Mn, Mw, etc) by end group analysis& viscometry, |
| | **11** | Determination of (Mn, Mw, etc) by light scattering and osmotic pressure methods. |
| | **Term III** | |
| | **12** | Determination of molecular weight of polymers |
| | **13** | Molecular weight distribution and its significance. Polydispersity index |
| | **14** | Problem & solution |
| | **15** | Problem & solution |
| | **Term I** | |
| | **01** | Course outcome and necessity of green chemistry |
| | **02** | What is Green Chemistry? Its development |
| | **03** | Need and Goals of Green Chemistry. |
| | **04** | Limitations/ Obstacles in the pursuit of the goals of Green Chemistry |
| | **05** | Twelve principles of Green Chemistry with their explanations and examples |
| | **06** | Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD |
| | **07** | Greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident |
| | **Term II** | |
| **DSE 3 T** | **08** | Safer route to cyclohexanol, subdivisions of ISD, |
| | **09** | Green solvents |
| | **10** | supercritical fluids, Supercritical water, Supercritical $CO_2$ |
| | **11** | water as a solvent for organic reactions, |
| | **12** | Ionic liquids, fluorous biphasic solvent, PEG, |
| | **13** | Solventless processes, immobilized solvents and how to compare greenness of solvents |
| | **Term III** | |
| | **14** | Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting |
| | **15** | Problem solving |
| | **16** | Problem solving |

# Teaching Plan - 2022-23 (Even semester)

PROF. KUHELI PRAMANIK
Department of Chemistry

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|---|---|---|
| **Semester II** | | |
| **Syllabus allotted** | CC4T (DSC-1B): ORGANIC CHEMISTRY-II (Theory) | |
| **C4T** | **Lecture No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome is discussed |
| | **02** | Aromatic hydrocarbons- preparation from phenol, by decararboxylation, acetylene, benzene sulfonic acid. |
| | **03** | Reactions –Electrophicilic substitutions (nitration, halogenations, sulphonation) |
| | **04** | Reactions-Friedle craft alkylation and acylation, side chain oxidation of alkyl benzenes. |
| | **05** | Alkyl halides-types of nucleophilic substitution reactions-SN1, SN2 and SNi |
| | **Term II** | |
| | **06** | Preparation – alkyl halide preparation from alkenes and alcohols |
| | **07** | Reactions-Hydrolysis, nitrite and nitro formation, Nitrile and iso nitrile formation |
| | **08** | Williamson's ether synthesis-Elimination vs substitution |
| | **09** | Aryl halides-Preparation from phenol, Sandmeyer &Gattermann reactions |
| | **10** | Reactions-Aromatic nucleophilic substitution and effect of nitro substituent |
| | **Term I** | |
| | **11** | Benzyne mechanism, Reactivity and relative strength of C- halogen bond in alkyl allyl, benzyl, vinyl and aryl halides |
| | **12** | Problem discussion |
| | **13** | Problem discussion |
| **Semester IV** | | |
| **Syllabus Allotted** | CC-10 T : ORGANIC CHEMISTRY-IV; Rearrangements (Theory)<br>CC 10 P: ORGANIC CHEMISTRY-IV Quantitative Estimations (Prac) | |

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| **CC-10 T** | **Lecture No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome, Definitions and classifications |
| | **02** | Mechanism with evidence and stereochemical features for the following Rearrangement to electron-deficient carbon: Wagner-Meerwein rearrangement, pinacol rearrangement |
| | **03** | dienone-phenol; Wolff rearrangement in Arndt-Eistert synthesis |
| | **04** | benzil-benzilic acid rearrangement, Demjanov rearrangement, Tiffeneau–Demjanov rearrangement. |
| | **05** | Rearrangement to electron-deficient nitrogen: Hofmann, Curtius rearrangements |
| | **06** | Rearrangement to electron-deficient nitrogen: Lossen, Schmidt and Beckmann. |
| | **Term II** | |
| | **07** | Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation |
| | **08** | Rearrangement to electron-deficient oxygen: cumene hydroperoxide-phenol rearrangement and Dakin reaction. |
| | **09** | Aromatic rearrangements: Migration from oxygen to ring carbon: Fries rearrangement and Claisen rearrangement. |
| | **10** | Migration from nitrogen to ring carbon: Hofmann-Martius rearrangement**,** Fischer-Hepp rearrangement, N-azo to C-azo rearrangement. |
| | **11** | Bamberger rearrangement, Orton rearrangement and benzidine rearrangement. |
| | **Term III** | |
| | **12** | Rearrangement reactions by green approach: Fries rearrangement, Claisen rearrangement |
| | **13** | Beckmann rearrangement, Baeyer-Villiger oxidation. |
| | **14** | Problem discussion |
| | **15** | Problem discussion |
| | **16** | Problem discussion |
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| **Syllabus Allotted** | GE-4T: **Chemical Analysis** | |
| | **Lecture No** | |
| | **Term I** | |

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| GE-4T | **01** | Gravimetric analysis: solubility product and common ion effect; requirements of gravimetry; |
| | **02** | gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc. |
| | **03** | Volumetric analysis: primary and secondary standard substances; principles of acidbase, oxidation –reduction |
| | **04** | complexometric titrations; indicators: acid-base, redox and metal ion |
| | **Term II** | |
| | **05** | principles of estimation of mixtures: NaHCO3 and Na2CO3 (by acidimetry) |
| | **06** | iron, copper, manganese and chromium (by redox titration) |
| | **07** | zinc, aluminum, calcium and magnesium (by complexometric EDTA titration) |
| | **08** | Chromatography: chromatographic methods of analysis: column chromatography |
| | **Term III** | |
| | **09** | Chromatography: thin layer chromatography. |
| | **10** | Assignments |
| | **11** | Problem discussion |
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# Semester VI

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| **Syllabus Allotted** | DSE-4T: Polymer Chemistry (Theory)<br>DSE-3P: Green Chemistry (Practical) | |
| **DSE-4T** | **Lecture** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome, Properties of polymers |
| | **02** | preparation, structure, properties and application of polyolefins |
| | **03** | preparation, structure, properties and application ofpolystyrene and styrene copolymers |
| | **04** | preparation, structure, properties and application of poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers |
| | **Term II** | |
| | **05** | preparation, structure, properties and application of acrylic polymers, fluoro polymers |
| | **06** | preparation, structure, properties and application of polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac) |
| | **07** | preparation, structure, properties and application of polyurethanes, silicone polymers, polydienes |

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| | **08** | preparation, structure, properties and application of Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)]. |
| | **Term III** | |
| | **09** | preparation, structure, properties and application of Polycarbonates |
| | **10** | Problem discussion |
| | **11** | Problem discussion |
| | **12** | Problem discussion |
| **DSE-2T** | DSE-2T: **Green Chemistry** | |
| | **Term I** | |
| | **01** | Course outcome, definition and necessity of green chemistry |
| | **02** | Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry |
| | **03** | Green Synthesis of the following compounds: adipic acid, catechol |
| | **04** | Green Synthesis of the following compounds: disodium iminodiacetate |
| | **05** | Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols |
| | **06** | microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction |
| | **Term II** | |
| | **07** | Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine) |
| | **08** | Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with $CO_2$ for precision cleaning and dry cleaning of garment |
| | **09** | Designing of Environmentally safe marine antifoulant |
| | **10** | Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments. |
| | **Term III** | |
| | **11** | Enzymatic Inter esterification for production of no Trans-Fats and Oils |
| | **12** | Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting |
| | **13** | Problem solving |
| | **14** | Problem solving |

# Teaching Plan : 2022-23 (Even semester)

DR. FORID SAIKH
Department of Chemistry

| | | |
|---|---|---|
| **Semester II** | | |
| **Syllabus allotted** | C4T: ORGANIC CHEMISTRY-II (Theory) **General Treatment of Reaction Mechanism II** | |
| **C4T** | **Lec no** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Rate constant and free energy of activation |
| | **02** | Concept of order and molecularity; free energy profiles for one-step, two-step and three-step reactions |
| | **03** | Catalyzed reactions: electrophilic and nucleophilic catalysis; |
| | **04** | Kinetic control and thermodynamic control of reactions |
| | **05** | Isotope effect: primary and secondary kinetic isotopic effect ($k_H/k_D$) |
| | **Term II** | |
| | **06** | Examples and different mechanisms |
| | **07** | Principle of microscopic reversibility; Hammond's postulate. |
| | **08** | free energy and equilibrium, enthalpy and entropy factor |
| | **09** | calculation of enthalpy change via BDE |
| | **Term III** | |
| | **10** | Exampleas and calculations of BDE |
| | **11** | intermolecular & intramolecular reactions |
| | **12** | Problem discussion |
| | **13** | Problem discussion |
| **Semester IV** | | |
| **Syllabus Allotted** | CC-10 T : ORGANIC CHEMISTRY-IV **The Logic of Organic Synthesis**(Theory)<br>CC 10 P :ORGANIC CHEMISTRY-IV Quantitative Estimations (Prac)<br>SEC 2T : BASIC ANALYTICAL CHEMISTRY (Theory)<br>SEC 2T: BASIC ANALYTICAL CHEMISTRY (Prac) | |
| | | |
| **CC-10 T** | **Lec No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | disconnections; synthons, donor and acceptor synthons; natural reactivity and *umpolung*; |
| | **02** | latent polarity in bifunctional compounds: consonant and dissonant polarity; illogical electrophiles and nucleophile |
| | **03** | synthetic equivalents (FGI and FGA) |
| | **04** | C-C disconnections 1,1 difunctional |
| | **05** | C-C disconnections 1,2 difunctional |
| | **06** | C-C disconnections 1,3 difunctional |
| | **Term II** | |
| | **07** | C-C disconnections 1,4 difunctional |

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|---|---|---|
| | **08** | C-C disconnections 1,5 difunctional |
| | **09** | reconnection (1,6-dicarbonyl) |
| | **10** | Protection deprotection strategy alcohol. |
| | **11** | Protection deprotection strategy amine, carbonyl, acid. |
| | **Term III** | |
| | **12** | *Strategy of ring synthesis:* thermodynamic and kinetic factors; synthesis of large rings, application of high dilution technique. |
| | **13** | stereoselective and stereospecific reactions |
| | **14** | diastereoselectivity and enantioselectivity: |
| | **15** | Assignments and problem discussion |
| | **16** | Assignments and problem discussion |
| | | |
| **SEC 2 T** | **Term I** | |
| | **01** | Course outcome and general importance of Basic Analytical Chemistry |
| | **02** | Necessity of error analysis |
| | **03** | Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. |
| | **04** | Presentation of experimental data and results, from the point of view of significant figures. |
| | **05** | Nutritional value of foods |
| | **06** | idea about food processing and food preservations |
| | **Term II** | |
| | **07** | Adulteration in food |
| | **08** | Definition, general introduction on principles of chromatography |
| | **09** | Paper chromatography, TLC |
| | **10** | Column, ion-exchange chromatography |
| | **11** | Major and minor constituents and their function of cosmetics |
| | **Term III** | |
| | **12** | Major and minor constituents and their function of cosmetics |
| | **13** | Major and minor constituents and their function of cosmetics |
| | **14** | Problem solving |
| | **15** | Problem solving |
| **Semester VI** | | |
| **Syllabus Allotted** | DSE3T: Green Chemistry (Theory)<br>DSE4T: Polymer Chemistry (Theory)<br>DSE4P: Polymer Chemistry (Practical) | |
| | **Lec no** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome, Properties of polymers |
| | **02** | Determination of crystalline melting point and degree of crystallinity |
| | **03** | Morphology of crystalline polymers, Factors affecting crystalline melting point. |

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|---|---|---|
| **DSE 4 T** | **04** | Structure Property relationships |
| | **05** | (*Mn, Mw,* etc) by end group analysis & viscometry |
| | **06** | (*Mn, Mw,* etc) by osmometry & light scatering |
| | **Term II** | |
| | **07** | Molecular weight distribution and its significance. Polydispersity index. |
| | **08** | Free volume theory, WLF equation |
| | **09** | Factors affecting glass transition temperature (Tg). |
| | **10** | preparation, structure, properties and application of polyolefins, polystyrene and styrene copolymer |
| | **11** | preparation, structure, properties and application of poly(vinyl chloride) and related polymers,poly(vinyl acetate) |
| | **Term III** | |
| | **12** | preparation, structure, properties and application of polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydiene |
| | **13** | preparation, structure, properties and application of Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide<br>polypyrrole, polythiophene) |
| | **14** | Problem & solution |
| | **15** | Problem & solution |
| **DSE 3 T** | **Term I** | |
| | **01** | Course outcome and necessity of green chemistry |
| | **02** | Green Synthesis of the following compounds: adipic acid, catechol |
| | **03** | Green Synthesis of disodium imino diacetate |
| | **04** | Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; |
| | **05** | Microwave assisted reactions in organic solvents |
| | **06** | Diels-Alder reaction and Decarboxylation reaction |
| | **07** | Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine) |
| | **Term II** | |
| | **08** | Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with $CO_2$ for precision cleaning and dry cleaning of garment |
| | **09** | Designing of Environmentally safe marine antifoulant |
| | **10** | Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments. |
| | **Term III** | |
| | **11** | Enzymatic esterification for production of no Trans-Fats and Oils |
| | **12** | Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting |
| | **13** | Problem solving |
| | **14** | Problem solving |

# Teaching Plan - 2022-23 (Even semester)

## DR. SUBHRA MISHRA

## Department of Chemistry

| **Semester II** | | |
|---|---|---|
| **Syllabus allotted** | CC4T: ORGANIC CHEMISTRY-II (Theory)Substitution and Elimination Reactions<br>CC4P: Organic Preparations<br>CC4T (DSc-1B): Alcohol, Phenol and Ethers | |
| **CC4T** | **Lec No** | **Topics to be covered** |
| | **01** | Course outcome of the topic |
| | **02** | **Substitution reaction:**Free-radical substitution reaction: halogentaion of alkanes, mechanism (with evidence) |
| | **03** | Stereochemical features; reactivity-selectivity principle in the light of Hammond's postulate. |
| | **04** | Nucleophilic substitution reactions: substitution at sp3 centre: mechanisms (with evidence) $S_N1$, $S_N2$, $S_Ni$ |
| | **05** | Relative rates &stereochemical features: $S_N1$, $S_N2$, $S_Ni$ |
| | **06** | Mechanisms (with evidence), relative rates &stereochemical features: of $S_N2'$, $S_N1'$ (allylic rearrangement) |
| | **07** | Effects of solvent, substrate structure, leaving group and nucleophiles |
| | **08** | Ambident nucleophiles-cyanide & nitrite and their effect on substitution |
| | **09** | Substitutions involving NGP (Mechanism, stereochemical consequences, Effect of structure, solvent etc.) |
| | **10** | Role of crown ethers and phase transfer catalysts; [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides]. |
| | **11** | **Elimination reactions:** E1, E2 (mechanism with evidence) |
| | **12** | Formation of alkenes and alkynes; E1, E2 mechanisms (with evidence), |
| | **13** | Formation of alkenes and alkynes; E1cB and Ei (pyrolyticsyn eliminations) |
| | **14** | Reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity; |
| | **15** | Comparison between substitution and elimination; importance of Bredt's rule relating to the formation of C=C. |
| | **16** | Problem discussion |
| | **17** | Problem discussion |
| **C4P** | | |
| **CC4T (DSc-1B** | **01** | Alcohol, Phenol and Ethers-program outcome discussion |
| | **02** | **Alcohols:** Preparation: Preparation, properties of 1°,2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, |
| | **03** | Preparation using reduction of aldehydes, ketones, carboxylic acid and ester |
| | | Reactions: With sodium, HX (Lucas test), esterification, |
| | **04** | Oxidation reaction with PCC, alk. $KMnO_4$, acidic dichromate, conc. $HNO_3$ |
| | **05** | Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. |
| | **06** | Pinacol-Pinacolone rearrangement, application, examples |
| | **07** | **Phenols:** Preparation: Cumenehydroperoxide method, from diazonium salts. |
| | **08** | Electrophilic substitution reactions (Nitration, halogenation and sulphonation) |
| | **09** | Reimer Tiemann Reaction, Gattermann-Koch Reaction,. |
| | **10** | Houben–Hoesch Condensation, Schotten – Baumann Reaction |
| | **11** | Problems discussion |
| | **12** | Assignment |
| **Semester IV** | | |
| **Syllabus Allotted** | SEC2T: BASIC ANALYTICAL CHEMISTRY(Theory) **Chromatography**<br>SEC 2T: BASIC ANALYTICAL CHEMISTRY (Practical)<br>SEC-2T: Analytical Clinical Biochemistry (Theory) | |

| | Lec No | Topics to be covered |
|---|---|---|
| | | **Term I** |
| | **01** | Course outcome of Basic Analytical Chemistry |
| | **02** | **Chromatography:** Definition, general introduction on principles of chromatography |
| | **03** | Paper chromatography-principle, methodology |
| | **04** | Procedure and and application |
| | **05** | General introduction of TLC, |
| | **06** | Procedure and uses |
| | | **Term II** |
| | **07** | **Ion-exchange:** Principle, procedure of Column chromatography |
| | **08** | Principle, procedure of Ion-exchange chromatography |
| **SEC 2 T** | **09** | Application of Ion-exchange chromatography |
| | **10** | **Analysis of cosmetics:** Major constituents and their function-I |
| | **11** | **Analysis of cosmetics:** Major constituents and their function-II |
| | | **Term III** |
| | **12** | Minor constituents and their function |
| | **13** | Problem discussion |
| | **14** | Problem discussion |
| | | **Term I** |
| | **01** | Program outcome and necessity of the course |
| | **02** | **Proteins:** Classification, biological importance |
| | **03** | Protein structure: Primary and secondary and tertiary structures of proteins |
| | **04** | Isolation, characterization of proteins |
| | **05** | Denaturation of proteins: Chemical and physical denaturant; Renaturation. |
| | **06** | **Enzymes:** Nomenclature, Characteristics and Classification |
| | **07** | Mechanism of enzyme action, Stereospecificity of enzymes |
| **SEC 2 T (4G)** | | **Term II** |
| | **08** | Active site, coenzymes, cofactors and enzyme inhibitors with example |
| | **09** | Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry |
| | **10** | **Biochemistry of disease:** Anemia**;Blood**-Composition and functions of blood, blood coagulation |
| | **11** | Blood collection and preservation methods ofsamples |
| | **12** | Biochemistry of diseases: Estimation and interpretation of data for blood sugar, urea, creatinine,cholesterol and bilirubin. |
| | | **Term III** |
| | **13** | **Urine:** Collection and preservation of samples. Formation of urine. |
| | **14** | Composition an estimation ofconstituents of normal and pathological urine |
| | **15** | Problems discussion |
| | | |

# Semester VI

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|---|---|
| **Syllabu** | DSE3T: Green Chemistry (Theory) |

| s Allotted | DSE4T: Polymer Chemistry (Theory)<br>DSE3P: Green Chemistry (Practical) | |
|---|---|---|
| | **Lec no** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome and application of green chemistry |
| | **02** | Twelve principles of Green Chemistry with explanations and examples (1 to 4) |
| | **03** | Twelve principles of Green Chemistry with explanations and examples (5 to 8) |
| | **04** | Twelve principles of Green Chemistry with explanations and examples (9 to 12) |
| | **05** | Introduction to Atom Economy, calculation of atom economy |
| | **06** | Calculation of atom economy for substitution and elimination reactions |
| | **07** | Designing a Green Synthesis using these principles, examples |
| | **08** | Prevention of Waste/ byproducts and its application |
| **DSE 3 T** | **09** | Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy |
| | **Term II** | |
| | **10** | Procedure for selection of starting materials; avoidance of unnecessary derivatization |
| | **11** | Catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis |
| | **12** | Biocatalysis, asymmetric catalysis and photocatalysis |
| | **13** | Future Trends in Green Chemistry: Oxidation reagents and catalysts; |
| | **Term III** | |
| | **14** | Combinatorial greenchemistry; Proliferation of solventless reactions |
| | **15** | Co crystal controlled solid state synthesis, Green chemistry in sustainable development |
| | **16** | Assignment and problem discussion |
| | **17** | Problem discussion |
| | **Term I** | |
| | **01** | Course outcome |
| | **02** | Functionality and its importance:Criteria for synthetic polymer formation. |
| | **03** | Classification of polymerization processes |
| | **04** | Relationships between functionality, extent of reaction and degree of polymerization |
| **SEC3 P** | **05** | Bifunctional systems, |
| | **06** | Poly-functional systems |
| | **07** | Kinetics of Polymerization :Mechanism and kinetics of step growth, radical chain growth, |
| | **Term II** | |
| | **08** | Mechanism and kinetics of copolymerization, |
| | **09** | Polymerization techniques |
| | **10** | Ionic chain (both cationic anionic) |
| | **11** | Coordination polymerizations |
| **DSE 4 T** | **Term III** | |
| | **12** | Mechanism and kinetics of copolymerization |
| | **13** | Problem solving |
| | **14** | Problem solving |

Teaching Plan - 2022-23 (Even semester)
DR. SUMIT KUMAR RAY
Department of Chemistry

| Semester II | | |
|---|---|---|
| **Syllabus allotted** | C4T: ORGANIC CHEMISTRY-II (Theory) Reaction Mechanism II<br>C3T: INORGANIC CHEMISTRY-I (Theory) Redox Reactions and precipitation reactions | |
| | **Lec No** | **Topics to be covered** |
| | **Term I** | |
| **C4T** | **01** | Course outcome |
| | **02** | Reaction thermodynamics: free energy and equilibrium, enthalpy and entropy factor,calculation of enthalpy change via BDE |
| | **03** | Calculation of enthalpy change via BDE, intermolecular & intramolecular reactions. |
| | **04** | Concept of organic acids and bases: effect of structure, substituent and solvent on acidity and basicity |
| | **05** | Proton sponge; gas-phase acidity and basicity; comparison between nucleophlicity and basicity; HSAB principle |
| | **06** | Application of thermodynamic principles in acid-base equilibria |
| | **07** | Tautomerism: prototropy (keto-enol, nitro - aci-nitro, nitroso-oximino, diazo-amino and enamine-imine systems) |
| | **Term II** | |
| | **08** | Valence tautomerism and ring-chain tautomerism; composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3-dicarbonyl systems, phenols and related systems) |
| | **09** | Factors affecting keto-enol tautomerism; |
| | **10** | Application of thermodynamic principles in tautomeric equilibria |
| | **11** | Reaction kinetics: rate constant and free energy of activation; concept of order and molecularity |
| | **12** | Free energy profiles for one-step, two-step and three-step reactions; catalyzed reactions |
| | **Term III** | |
| | **13** | Electrophilic and nucleophilic catalysis; kinetic control and thermodynamic control of reactions; isotope effect |
| | **14** | Primary and secondary kinetic isotopic effect ($k_H/k_D$); principle of microscopic reversibility; Hammond's postulate. |
| | **15** | Problem discussion |
| | **16** | Problem discussion |
| **C3T** | **Term I** | |
| | **01** | Course Outcome |
| | **02** | Ion-electron method of balancing equation of redox reaction. |
| | **03** | Elementary idea on standard redox potentials with sign conventions, |
| | **04** | Nernst equation |
| | **05** | Influence of complex formation, precipitation and change of pH on redox potentials; formal potential. |
| | **06** | Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. |
| | **Term II** | |
| | **07** | Redox potential diagram (Latimer) of common elements and their applications. |

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|---|---|---|
| | **08** | Frost diagrams |
| | **09** | Disproportionation and comproportionation reactions (typical examples) |
| | **10** | Complementary and Non Complementary redox reaction |
| | **11** | Equivalent weight calculation |
| | **Term III** | |
| | **12** | Solubility product principle, common ion effect |
| | **13** | Applications of solubility product to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides |
| | **14** | Problem discussion |
| | **15** | Problem discussion |

## Semester IV

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|---|---|
| **Syllabus Allotted** | CC-10 T : ORGANIC CHEMISTRY-IV Nitrogen compounds (Theory)<br>CC 10 P :ORGANIC CHEMISTRY-IV Quantitative Estimations (Prac)<br>CC-9 T: INORGANIC CHEMISTRY-III<br>CC-9 P: COMPLEXOMETRIC TITRATION |

| | | |
|---|---|---|
| **CC-10 T** | **Lecture No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome of CC 10 T & P |
| | **02** | Amines: Aliphatic & Aromatic: preparation |
| | **03** | Separation (Hinsberg's method) and identification of primary, secondary and tertiary amines |
| | **04** | Eschweiler–Clarke methylation : Application. |
| | **05** | Diazo coupling reaction |
| | **06** | Mannich reaction : Application in organic synthesis |
| | **07** | Formation and reactions of phenylenediamines |
| | **Term II** | |
| | **08** | Diazomethane and diazoacetic ester. |
| | **09** | Nitro compounds (aliphatic and aromatic): preparation and reactions. |
| | **10** | Reduction of nitro compounds under different conditions; Nef carbonyl synthesis |
| | **11** | Alkylnitrile and isonitrile: preparation and reaction (with mechanism) |
| | **12** | Thorpe nitrile condensation, von Richter reaction. |
| | **Term III** | |
| | **13** | Diazonium salts and their related compounds: reactions |
| | **14** | Reactions of Diazonium salts |
| | **15** | Gomberg, Meerwein and Japp-Klingermann reactions. |
| | **16** | Assignments and problem discussion |

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| | **Term I** | |
| | **01** | Course outcome and general concepts of s and p Block Elements |
| | **02** | Diagonal relationship and anomalous behaviour of first member of each group |

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|---|---|---|
| **CC-9 T** | **03** | Allotropy and catenation |
| | **04** | Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Beryllium hydrides and halides. |
| | **05** | Boric acid and borates, boron nitrides |
| | **06** | Borohydrides (diborane) and graphitic compounds |
| | **07** | Silicates |
| | **Term II** | |
| | **08** | Silanes, Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine |
| | **09** | Peroxo acids of sulphur |
| | **10** | Sulphur-nitrogen compounds |
| | **11** | Interhalogen compounds |
| | **12** | polyhalide ions, pseudohalogens , |
| | **Term III** | |
| | **13** | Fluorocarbons and basic properties of halogens |
| | **14** | Assignments and problem discussion |
| | **15** | Problem solving |
| **Semester VI** | | |
| **Syllabus Allotted** | C13T: Inorganic Chemistry-V Bioinorganic Chemistry | |
| **C13T** | **Lec no** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Course outcome |
| | **02** | Elements of life: essential and beneficial elements, major, trace and ultratrace elements |
| | **03** | Basic chemical reactions in the biological systems and the role of metal ions |
| | **04** | Metal ion transport across biological membrane $Na^+/K^+$-ion pump |
| | **05** | Dioxygen molecule in life |
| | **06** | Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin , |
| | **07** | Electron transfer proteins: Cytochromes and Ferredoxins. |
| | **Term II** | |
| | **08** | Hydrlytic enzymes: carbonate bicarbonate buffering system and carbonic anhydrase and carboxyanhydrase A |
| | **09** | Biological nitrogen fixation |
| | **10** | Photosynthesis: Photosystem-I and Photosystem-II. , |
| | **11** | Toxic metal ions and their effects, chelation therapy |
| | **12** | Pt and Au complexes as drugs |
| | **Term III** | |
| | **13** | Metal dependent diseases |
| | **14** | Problem & solution |
| | **15** | Problem & solution |

# Teaching plan: 2022-23 (Even Semester)
# Kalyan Sur
# Dept. of Chemistry

<table>
<tr><th colspan="3">Semester II</th></tr>
<tr><td>Syllabus allotted</td><td colspan="2">DSC – IBT: Ionic equilibria:<br>(Theory) Alcohols , Phenols and ethers</td></tr>
<tr><td></td><td colspan="2">C3T: Chemical Periodicity</td></tr>
<tr><td>DSC – IBT</td><td>Lec No</td><td>Topics to be covered</td></tr>
<tr><td rowspan="15">Alcohols, phenols & ethers</td><td colspan="2">Term I</td></tr>
<tr><td>01</td><td>Prep$^{n}$ of $1^{0}$, $2^{0}$ and $3^{0}$ alcohols, Ester hydrolysis reduction of aldehydes, ketones, carboxylic acids and esters.</td></tr>
<tr><td>02</td><td><u>Reaction:</u> with Na, HX (Lucas Test), victor mayer method, Esterification, oxid$^{n}$ with Pcc, alkaline $KMno_4$, acidic dichromate, Conc. $HNO_3$</td></tr>
<tr><td>03</td><td>Opprnaur oxid$^{n}$, diols: oxid$^{n}$ of diols. MPV reduction, Piracol – Pinacolone Rearrangement.</td></tr>
<tr><td>04</td><td>Prepn. Of Phenol, Cumenephenol process from diazonium salts<br><u>Reactions:</u> Electrophilic Substitution, Nitration, halogenations & Sulphonation.</td></tr>
<tr><td>05</td><td>Reimer-tiemann reaction, Gattermann-koch reaction, Houben-Hoesch Condensation, Schotten-Baumann Reaction.</td></tr>
<tr><td>06</td><td>PYQ’s discussion.</td></tr>
<tr><td>07</td><td>Frequently asked Questions (FAQ’s) Discussion.</td></tr>
<tr><td colspan="2">Term II</td></tr>
<tr><td></td><td></td></tr>
<tr><td>08</td><td>Moderate, strong & weak electrolyte, degree of ionisation factors affecting degree of ionisation, ionisation constants.</td></tr>
<tr><td>09</td><td>Ionic product of water. Ionisation of weak acids & Bases, pH scale; common ion effect.</td></tr>
<tr><td>10</td><td>Salt hydrolysis – calculation of hydrolysis constant Degree of hydrolysis and pH of different salts.</td></tr>
<tr><td>11</td><td>Buffer solutions, solubility and solubility pdt of sparingly soluble salts – application of solubility product Principle.</td></tr>
<tr><td>12</td><td>Numerical practice.</td></tr>
<tr><td>13</td><td>PYQ’s Discussion</td></tr>
<tr><td>14</td><td>FAQ’s discussion.</td></tr>
<tr><td>Syllabus Allotted</td><td colspan="2">Paper C3T: Chemical Periodicity</td></tr>
<tr><td rowspan="8">Chemical Periodicity</td><td colspan="2">Term I</td></tr>
<tr><td>01</td><td>Modern IUPAC Periodic Table, Effective nuclear charge, Screening effects and penetration, slater’s Rule</td></tr>
<tr><td>02</td><td>Atomic radii, ionic radii, Covalent radii Lanthanide contruction</td></tr>
<tr><td>03</td><td>IP, electron gain enthalpy, EN. (Pauling’s, Mulliken’s and AR scales)</td></tr>
<tr><td>04</td><td>Factors affecting these properties, group electronegativities group trends & Periodic trends in these properties in respect of S, p and d-block elements.</td></tr>
<tr><td>05</td><td>Secondary periodicity, Relativistic effect, Inert pair effect.</td></tr>
<tr><td>06</td><td>PYQ’s MCQ’s</td></tr>
<tr><td>07</td><td>FAQ’s, most probable Question discussion</td></tr>
<tr><th colspan="3">Semester IV</th></tr>
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|---|---|---|
| **Syllabus Alloted** | **C9T: Inorganic Chemistry-III**<br>**{Noble gases, inorganic polymers.}**<br>**DSC IDT: Transition elements (3d series) Coordination chemistry, CFT.** | |
| **C9T**<br><br>**Inorganic Chemistry-III** | **Lec No.** | **Topics to be Covered** |
| | **Term I** | |
| | **01** | **Noble gases:-** occurrence and uses, rationalisation of inertness of noble gases; |
| | | Clathrates; prepn. & properties of $XeF_2$, $XeF_4$ and $XeF_6$. |
| | **02** | Nature of bonding in noble gas compounds (VBT & MOT). |
| | **03** | Xenon-oxygen compds, |
| | **04** | Molecular shapes of noble gas compounds (VSEPR Theory) |
| | **05** | Assignments |
| | **06** | PYQ's, MCQ's, FAQ's |
| | **Term II** | |
| | **07** | **Inorganic polymers:** Types of inorganic polymers,. |
| | **08** | composition with organic polymers, synthesis, structure and applications of silicone |
| | **09** | Composition with organic polymers, synthesis, structure and applications siloxanes |
| | **10** | Borazines, phosphazenes. |
| | **Term III** | |
| | **11** | Silicates. |
| | **12** | PYQ's, FAQ's, MCQ's |
| | **13** | Problem discussion |
| | | |
| **Transitions elements and coordination Chemistry.** | **Lect No.** | **Topics to be covered** |
| | **Term I** | |
| | **01** | General group trends wrt EC, valency, colour, magnetic property and catalytic properties |
| | **02** | Ability to form completes and stability of various oxidation state (Latimer diagrams) for Mn, Fe & Cu. |
| | **03** | Lanthanoids and actinoids:- EC, OS, colour, magnetic proper |
| | **Term II** | |
| | **04** | Lanthanide contruction, separation of lanthadies. (ion exchange method) |
| | **05** | CFT, oh. Symmetry, CFSE, crystal field effects of weak and strong fields. |
| | **06** | Tetrahedral symmetry, factors affecting the magnitude of D., spectrochemical series. |
| | **07** | Comparison of CFSE for oh and Td completes, Tetragonal distortion of oh. Geometry. |
| | **Term III** | |
| | **08** | Jahn-Teller distortions, square planar coordination. |
| | **09** | Qus.-Ans. Discussion |
| | **10** | PYQ's and MCQ's. |
| **Semester VI** | | |
| **Syllabus Allotted** | CI3T: organometallic Chemistry | |
| | **Lec** | **Topics to be covered** |

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| | **no** | |
| | **Term I** | |
| | **01** | Definition and classification of OMC on the basis of bond type. |
| | **02** | Concept of hapticity of organic ligands; Formal charge |
| | **03** | 18-electron and 16 ē rules (pictorial mo approach). |
| | **04** | Application of 18 ē rule to metal carbonyls; nitrosyls and cyanides. |
| | **05** | General methods of preparation of mono and binuclear carbonyls of 3D-series. |
| | **Term II** | |
| | **06** | Structures of mononuclear and binuclear carbonyls. |
| | **07** | π-acceptor ligands, π-acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back-bonding |
| | **08** | Zeise's salts: prepn., structure, evidences of synergic effect. |
| | **09** | Ferrocene: prepn., reactions (acetylation, alkylation, metallation) |
| | **10** | Mannich condensation. |
| | **Term III** | |
| | **11** | Reactions of om complexes: substitution, oxidative addition |
| | **12** | Reductive elimination and insertion reactions. |
| | **13** | Questions and Discussion. |
| | **14** | PYQ's of JAM & CSIR NET and SET exam. |

# Teaching Plan - 2022-23 (Even semester)

Sanjoy Kumar Bera
Department of Chemistry

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| **Semester II** | | |
| **Syllabus allotted** | DSC2P: physical+Organic practical<br>No Theory classes | |
| **Semester IV** | | |
| **Syllabus Allotted** | GE4T: Conductance, Solutions.<br>DSC4T: chemical kinetics, solids<br>GE4P: physical+ Analytical and Environmental chemistry (prac)<br>SEC2P: qualitative and quantitative Identification and estimation of carbohydrates, proteins,lipids practical | |
| | | |
| GE4T | **Lec No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Definition of conductance, cell constant, specific and equivalent Conductance and their relationship. |
| | **02** | Variation of specific and equivalent Conductance with dilution, kohlrausch's law, numerical problem. |
| | **03** | Ostwald's dilution law, application of conductance measurement( Determination of solubility and ionic product of water) |
| | **04** | Definition of transport number, abnormal transport number,How transport number change with temperature and concentration. |
| | **05** | Principles of Hittorf's equation and moving boundary method for determining transport number. |
| | **06** | Numerical problem solution. |
| | **07** | Previous year question ans discussion. |
| | **Term II** | |
| | **08** | Tutorial classes. |
| | **09** | Definition of Ideal , non Ideal solutions,and Raoult's law, devia of Raoult's law - non ideal solution. |
| | **10** | Vapour pressure composition and temperature - composition curves for Ideal and non ideal solutions. |
| | **11** | Distillation of Solutions Lever rule Azeotropes critical solution temperature. |
| | **12** | Effect of impurities of partial miscibility of liquids. |
| | **13** | Principles of steam distillation and it's applications. |
| | **Term III** | |
| | **14** | Nernst distribution law and it's applications. |
| | **15** | Solvent extraction and it's applications. |
| | **16** | Question answer discussion. |
| | **Term I** | |
| | **01** | The concept of reaction rates. Effect of temperature, pressure, catalyst on |

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| DSC4T | | reaction rates. |
| | **02** | Order and molecularity of a reaction,. Derivation of integrated rate equations for zero, first and second order reactions. |
| | **03** | Half life equations for zero, first, second order reactions, unit of rate constants. |
| | **04** | General methodsbfor determination of order of a reactions. |
| | **05** | Concept of activation energy, Arrhenius equation and it's application. |
| | **06** | Collision theory and activated complex theory of bimolecular reactions. |
| | **07** | Numerical problem discussion. |
| | **08** | Forms of solids, symmetry elements, unit cells, crystal system concept |
| | **Term II** | |
| | **09** | Types of Bravais Lattice and identification of lattice planes. |
| | **10** | Law of crystallography, concept of interfacial angles, law of rational indices. |
| | **11** | Concept of Miller indices, x - Ray diffraction by crystal, Bragg's law. |
| | **12** | Structure of NaCl, kCl, CsCl( qualitative treatment only). |
| | **Term III** | |
| | **13** | Defects in crystals. |
| | **14** | Glasses and liquid crystal. |
| | **15** | Numerical problem solving |
| | **16** | Unit questions answers discussion. |
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| **Semester VI** | | |
| **Syllabus Allotted** | DSE2T:Green chemistry<br>DSE2P: Green synthesis practical | |
| **DSE 2T** | **Lect** | **Topics to be covered** |
| | **Term I** | |
| | **01** | What is Green chemistry? Need, Goals, Limitations of green chemistry |
| | **02** | Obstacles in the pursuit of the goals of green chemistry. |
| | **03** | Twelve principles of Green chemistry and explanations and examples. |
| | **04** | Designing a Green synthesis, prevention of waste and byproducts. |
| | **05** | Prevention/ minimization of toxic products reducing toxicity. |
| | **06** | Use of Green solvents. |
| | **Term II** | |
| | **07** | Energy requirements for reactions -use of microwaves and ultrasonic energy. |
| | **08** | Selection of starting materials, avoidance of unnecessary derivatization. |
| | **09** | Use of catalytic reagents for Green synthesis. |
| | **10** | Prevention of chemical accidents Designing greener processe. Principle of ISD.,Bhopal Gas tragedy. |
| | **Term III** | |
| | **11** | Strengthening/ development of analytical techniques to prevent and minimize the hazardous substances in chemical process |
| | **12** | Tutorial class |
| | **13** | Question answer discussion |

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| | **14** | Problem solving |
| | **15** | All unit problem discussion. |

Teaching Plan - 2022-23 (Even semester)
Laboni Giri
Department of Chemistry

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| **Semester II** | | |
| **Syllabus allotted** | DSC2P: physical+Organic practical | |
| **Semester IV** | | |
| **Syllabus Allotted** | CC9T:Co-Ordination chemistry -l<br>GE4T: Environmental chemistry<br>DSC4T: Kinetic Theory of gases, Liquid state<br>GE4P: physical+ Analytical and Environmental chemistry (prac)<br>SEC2P: qualitative and quantitative Identification and estimation of carbohydrates, proteins,lipids practical | |
| | | |
| | **Lec No** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Introduction of Coordinate bonding |
| | **02** | Defination of Double salt and complex salt |
| | **03** | Sidwick concept of co-ordinate bond,limitation of sidwick concept |
| | **04** | Pauling's Electroneutraluty principle,application of this principle |
| | **05** | Werner's theory of coordination complexes, |
| | **06** | Classification of ligands, defination of ligands and examples |
| | **07** | Defination of Ambidentate ligands, chelating ligand,Flexidentate ligands and examples |
| | **Term II** | |
| CC9T | **08** | Previous year question answer discussion |
| | **09** | Tutorial classes |
| | **10** | Coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers |
| | **11** | Discussion about Isomerism in coordination compounds |
| | **12** | constitutional and stereo isomerism,example |
| | **13** | Geometrical and optical isomerism in square planar complexes |
| | **Term III** | |
| | **14** | Geometrical and optical isomerism in octahedral complexes |
| | **15** | Chapter revision |
| | **16** | Previous year Question answer discussion. |
| | **Term I** | |
| DSC4T | **01** | Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation |
| | **02** | viation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases |

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| | **03** | Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation |
| | **04** | Andrews isotherms of CO2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation –derivation not required) and their importance. |
| | **05** | Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation) |
| | **06** | Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. |
| | **07** | Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only). |
| | **Term II** | |
| | **08** | Numerical problem solve |
| | **09** | Previous year question answer discussion |
| | **10** | Surface tension and its determination using stalagmometer. |
| | **11** | Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer |
| | **12** | Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). |
| | **Term III** | |
| | **13** | Tutorial class |
| | **14** | Question ans answer discussion |
| | **15** | Previous year question answer discussion |
| | **Term I** | |
| GE4T | **01** | The Atmosphere: composition and structure of the atmosphere; troposphere, stratosphere, mesosphere and thermosphere; ozone layer and its role. |
| | **02** | Major air pollutants: CO, SO2, NOx and particulate matters – their origin and harmful effects. |
| | **03** | Problem of ozone layer depletion; green house effect; acid rain and photochemical smog. |
| | **04** | Air pollution episodes: air quality standard; air pollution control measures: cyclone collector, electrostatic precipitator, catalytic converter. |
| | **05** | The Hydrosphere: environmental role of water, natural water sources. |
| | **06** | Water treatment for industrial, domestic and laboratory uses. |
| | **07** | Water pollutants; action of soaps and detergents, phosphates, industrial effluents, agricultural runoff, domestic wastes. |
| | **Term II** | |
| | **08** | Thermal pollution, radioactive pollution and their effects on animal and plant leaf |
| | **09** | Water pollution episodes: water pollution control measures : waste water treatment; |
| | **10** | Water pollution control measures :chemical treatment and microbial treatment |
| | **11** | Water quality standards: DO,BOD,COD,TDS and hardness parameter |
| | **12** | Desalination of sea water : reverse osmosis,electrodialysis |
| | **Term III** | |

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| | **13** | The Lithosphere: water and air in soil, waste matters and pollutants in soil |
| | **14** | Waste classification, treatment and disposal. |
| | **15** | soil pollution and control measures. |
| | **16** | Unit questions answers discussion. |
| | | |
| **Semester VI** | | |
| **Syllabus Allotted** | CC- 13T:Catalysis by Organometallic Compounds DSE2P: Green synthesis practical | |
| **CC13T** | **Lec no** | **Topics to be covered** |
| | **Term I** | |
| | **01** | Synthetic and catalytic applications of organometallic compounds |
| | **02** | Classification of catalyst on the basis of nature and physical state |
| | **03** | Theory of homogeneous and heterogeneous catalyst. |
| | **04** | Defination of homogeneous and heterogeneous catalyst,TON(Turn over number) |
| | **05** | Hydrogenation of alkenes using of wilkinson's catalyst,features of wilkinson catalyst. |
| | **06** | Hydroformylation reaction(oxo process) |
| | **Term II** | |
| | **07** | Wacker Process and mechanism |
| | **08** | Synthetic gasoline (Fischer Tropsch reaction) |
| | **09** | Ziegler-Natta catalysis for olefin polymerization. |
| | **10** | All unit revision |
| | **11** | Tutorial class |
| | **Term III** | |
| | **12** | Previous year question answer discussion |
| | **13** | Question answer discussion |
| | **14** | Problem solving |
| | **15** | All unit problem discussion. |