Government of Maharashtra

Ismail Yusuf College Jogeshwari (E),

Mumbai-400 060

Department of Chemistry

F.Y.B.Sc. Sem-I | Paper- I | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : (a) Chemical Thermodynamics** **Thermodynamic terms;** ❖ System, ❖ surrounding, ❖ boundaries, ❖ types of system, ❖ Intensive and Extensive properties, ❖ State functions and path functions, ❖ Thermodynamic processes.	Chalk & Board
2.	2 Week	**First law of thermodynamics:** ❖ Concept of heat (q), ❖ work (w), ❖ internal energy (U), ❖ enthalpy, ❖ heat capacity, ❖ relation between heat capacities, ❖ sign conventions, ❖ calculations of heat, ❖ work, ❖ internal energy and enthalpy (H).	Chalk & Board
3.	3 Week	**Thermochemistry:** ❖ Heat of reactions, ❖ Standard states, ❖ Enthalpy of formation of molecules, ❖ Enthalpy of combustion and its applications, ❖ Calculations of bond energy, ❖ Bond dissociation energy and resonance energy from thermochemical data.	Chalk & Board
4.	4 Week	**Kirchhoff's equation** ❖ Numerical problems **Chemical Calculations:** Methods of expressing concentration of solutions: ❖ Normality ❖ Molarity, ❖ Formality	Chalk & Board
5.	5 Week	**Chemical Calculations:** Methods of expressing concentration of solutions: ❖ Molarity, ❖ Formality, ❖ Mole fractions, ❖ Weight ratio,	Chalk & Board

		❖ Volume ratio, ❖ Weight to volume ratio, ❖ ppm, ❖ ppb, ❖ millimoles, ❖ milliequivalents, ❖ Preparation of solutions. ❖ Numerical	
6.	6 Week	**Historical perspectives of the atomic structure;** ❖ J. J. Thomson Model, ❖ Rutherford's Atomic Model- alpha particle scattering experiment, ❖ Bohr's theory, its limitations and atomic spectrum of hydrogen atom. ❖ Structure of hydrogenatom.	Chalk & Board
7.	7 Week	**Hydrogenicatoms:** 1. Simple principles of quantummechanics 2. Atomic orbitals i) Hydrogenic energylevels ii) Shells, subshells and orbitals iii) Electronspin	Chalk & Board
7	8 Week	**Hydrogenicatoms:** 2. Atomic orbitals iv) Radial shapes oforbitals v) Angular shapes oforbitals. ❖ Aufbauprinciple, ❖ Hund's rule of maximum multiplicity and ❖ Pauli exclusion principle	Chalk & Board
9	9 Week	**Periodic Table and periodicity:** **Long form of Periodic Table;** ❖ Classification for elements as main group, transition and inner transition elements. ❖ Periodicity in the following properties: Atomic and ionic size, electron gain enthalpy, ionization enthalpy	Chalk & Board
10	10 Week	**Periodicity in the following properties:** ❖ Effective nuclear charge (Slater's rule), ❖ Electronegativity, ❖ Pauling and Mulliken methods. ❖ Numerical	Chalk & Board
11	11 Week	**Unit III Basics of Organic Chemistry** **Classification and Nomenclature of Organic Compounds:** ❖ Nomenclature of mono and bi-functional aliphatic	Chalk & Board

		compounds on the basis of priority order of the following classes of compounds: Alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones	
12	12 Week	**Classification and Nomenclature of Organic Compounds:** ❖ Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines and their cyclic analogues	Chalk & Board
13	13 Week	**Bonding and Structure of organic compounds:** **Hybridization:** ❖ sp3, sp2, sp hybridization of carbon and nitrogen; ❖ sp3 and sp2 hybridizations of oxygen in Organic compounds (alcohol, ether, aldehyde, ketone, carboxylic acid, ester, cyanide, amine and amide) ❖ Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds, shapes of organic molecules. ❖ Shapes of molecules; Influence of hybridization on bond properties (as applicable to ethane, ethene, ethyne).	Chalk & Board
14	14 Week	**Fundamentals of organic reaction mechanism:** **Electronic Effects:** ❖ Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications. ❖ Dipole moment; ❖ Organic acids and bases; their relative strengths. ❖ Basic terms & concepts:: Homolytic and Heterolytic fission with suitable examples. ❖ Electrophiles and Nucleophiles; ❖ Nucleophilicity and basicity, ❖ Electrophilicity and acidity.	Chalk & Board
15	15 Week	❖ Types (primary, secondary, tertiary, allyl, benzyl), shape and their relative stability of the following reactive intermediates: i. Carbocations ii. Carbanions and iii. Free radicals ❖ Introduction to types of organic reactions: Addition, Elimination and Substitution reaction. (With one example of each)	Chalk & Board

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Department of Chemistry

F.Y.B.Sc. Sem-I | Paper- II | Lecture Plan

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1.	1 Week	**Unit 1 : (a) Chemical Thermodynamics-II** ❖ Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature. ❖ Numericals	Chalk & Board
2.	2 Week	❖ Gibbs-Helmholtz equation, van't Hoff reaction isotherm and van't Hoff reaction isochore. ❖ Numericals	Chalk & Board
3.	3 Week	❖ Thermodynamics of Open System: Partial Molal Properties, Chemical Potential and its variation with Pressure and Temperature, Gibb's Duhem equation. ❖ Concept of Fugacity and Activity	Chalk & Board
4.	4 Week	**Unit I: (b) Electrochemistry** ❖ Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. ❖ Kohlrausch law of independent migration of ions. ❖ Applications of conductance measurements: determination of degree of ionization and ionization constant of weak electrolyte, solubility and solubility product of sparingly soluble salts, ionic product of water.	Chalk & Board
5.	5 Week	❖ Transference number and its experimental determination using Moving boundary method. ❖ Factors affecting transference number. ❖ Numericals	Chalk & Board
6.	6 Week	**Unit II: Chemical Bonding** **(a) Non-Directional Bonding** 1 Ionic Bond: Conditions for the Formation of Ionic Bond. 2 Types of Ionic Crystals 3 Radius Ratio Rules 4 Lattice Energy, 5 Borne-Lande Equation 6 Kapustinski Equation 7 Born-Haber Cycle and its Application	Chalk & Board

7.	7 Week	(b) Directional Bonding: Orbital Approach. ❖ Covalent Bonding The Valence Bond Theory- Introduction and basic tenets. ❖ Interaction between two hydrogen atoms and the Potential energy diagram of the resultant system. ❖ Corrections applied to the system of two hydrogen atoms- Formation of H_2 ❖ Homonuclear diatomic molecules from He_2 to Ne_2 ❖ Resonance and the concept of Formal Charge; Rules for Resonance or Canonical structures.	Chalk & Board
7	8 Week	**(b) Directional Bonding: Orbital Approach** ❖ Bonding in Polyatomic Species: The role of Hybridization. And types of hybrid orbitals-sp, sp^2, sp^3, sp^3d, $sp^3d^3$and sp^2d sp^3d^2. ❖ Equivalent and Non-Equivalent hybrid orbitals ❖ Contribution of a given atomic orbital to the hybrid orbitals (with reference to sp3 hybridisation as in CH4, NH3 and H_2O and series like NH_3, PH_3, AsH_3, BiH_3)	Chalk & Board
9	9 Week	**(c) Molecular Orbital Theory** ❖ Comparing Atomic Orbitals and Molecular Orbitals. ❖ Linear combination of atomic orbitals. to give molecular orbitals LCAO MO approach for diatomic homonuclear molecules). ❖ Wave mechanical treatment for molecular orbital (H_2^+ & H_2)	Chalk & Board
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11	11 Week	**Unit III: Organic Chemistry** **(a) Reactions and reactivity of halogenated hydrocarbons:** ❖ **Alkyl halides**: Nucleophilic substitution reactions: SN^1, SN^2 and SNi mechanisms with stereochemical aspects and factors affecting nucleophilic substitution reactions-nature of substrate, solvent, nucleophilic reagent and leaving group. ❖ **Aryl halides**: Reactivity of aryl halides towards nucleophilic substitution reactions.	Chalk & Board
12	12 Week	❖ **Aryl halides:** Nucleophilic aromatic substitution (SNAr) addition-elimination mechanism and benzyne mechanism. ❖ Organomagnesium and organolithium compounds: ❖ Nomenclature, nature, type and reactivity of carbon-metal bond. Preparation using alkyl / aryl halide. Structure, stability and reactions with compounds containing acidic hydrogen, carbonyl compounds, CO_2.	Chalk & Board

13	13 Week	**Organomagnesium and organolithium compounds:** ❖ Structure, stability and reactions with compounds containing cyanides and epoxides **Alcohols, phenols and epoxides:** ❖ Alcohols: Nomenclature, Preparation: Hydration of alkenes, hydrolysis of alkyl halides, reduction of aldehydes and ketones, using Grignard reagent. Properties: Hydrogen bonding, types and effect of hydrogen bonding on different properties. Acidity of alcohols, Reactions of alcohols	Chalk & Board
14	14 Week	❖ **Phenols:** Preparation, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols.	Chalk & Board
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Name of the Teacher

Dr. Tulshiram Dadmal

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Department of Chemistry

F.Y.B.Sc. Sem-II | Paper- II | Lecture Plan

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1.	1 Week	**Unit 1 : (a) Chemical Thermodynamics-II** ❖ Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature. ❖ Numericals	Chalk & Board
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Name of the Teacher

Dr. Dattatreya Bhangre

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Department of Chemistry

S.Y.B.Sc. Sem-III | Paper- II | Lecture Plan

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1.	1 Week	**Unit 1 : (a) Chemical Thermodynamics-II** ❖ Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature. ❖ Numericals	Chalk & Board
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Name of the Teacher

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S.Y.B.Sc. Sem-III | Paper I | Lecture Plan

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		❖ Interaction between two hydrogen atoms and the Potential energy diagram of the resultant system. ❖ Corrections applied to the system of two hydrogen atoms-Formation of H_2 ❖ Homonuclear diatomic molecules from He_2 to Ne_2 ❖ Resonance and the concept of Formal Charge; Rules for Resonance or Canonical structures.	
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14	14 Week	❖ **Phenols:** Preparation, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols.	Chalk & Board
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Name of the Teacher

Dr. Bapu Thorat

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S.Y.B.Sc. Sem-III | Pape- II | Lecture Plan

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S.Y.B.Sc. Sem-III | Paper- II | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : Methods of separation** (a) Separation Techniques in Analytical Chemistry ❖ An Introduction to Analytical Separations and its importance in analysis. ❖ Estimation of an analyte without effecting separation. ❖ Types of separation methods ❖ Based on Solubilities (Precipitation, Filtration Crystallisation) ❖ Based on Gravity- Centrifugation Based on volatility- Distillation ; ❖ Based on Electrical effects-Electrophoresis ❖ Based on retention capacity of a Stationary Phase - Chromatography; ❖ Based on distribution in two immiscible phases-Solvent Extraction; ❖ Based on capacity to exchange with a resin-Ion Exchange; **Electrophoresis:** Principles, Basic Instrumentation, Working and Application in separation of biomolecules like enzymes and DNA.	Chalk & Board
2.	2 Week	**(b) Solvent extraction** ❖ Introduction, ❖ Nernst distribution Law, ❖ Distribution Ratio, ❖ Partition Coefficient. ❖ Conditions of extraction: Equilibration time, Solvent volumes, temperature, pH.	Chalk & Board
2	3 Week	**(b) Solvent extraction** ❖ Single step and multi step extraction, Percentage extraction for single step and multistep extraction. Separation factor. ❖ Batch and continuous extraction.	Chalk & Board
3	4 Week	**(c) Chromatography:** ❖ Introduction to Chromatography ❖ Classification of chromatographic methods based on stationary and mobile phase ❖ Paper Chromatography: Principle, techniques and applications of Paper Chromatography in separation of cations.	Chalk & Board

4	5 Week	**(c) Chromatography:** ❖ Thin layer Chromatography ❖ Principle, ❖ technique and Applications in determining the purity of a given solute; ❖ Following progress of a given reaction .	Chalk & Board
6	6 Week	**Unit II:** Instrumental Methods-II a) Instruments based on the electrochemical properties of the analytes (i) Potentiometry: ❖ Principle. ❖ Role of Reference and indicator electrodes ❖ Applications in Neutralisation reactions with reference to the titration of a Strong acid against a Strong Base (using quinhydrone electrode)	Chalk & Board
7	7 Week	(i) Potentiometry: ❖ Applications in Neutralisation reactions with reference to the titration of a Strong acid against a Strong Base (using quinhydrone electrode) ❖ Graphical methods for detection of end points	Chalk & Board
7	8 Week	(ii) pHmetry: ❖ Principle ❖ Types of pH meters. ❖ Principle, Construction Working and Care of Combined Glass electrode ❖ Applications in Titrimetry (Strtong acid-Strong Base) biological and environmental analysis.	Chalk & Board
9	9 Week	(ii) Conductometry: ❖ Principle ❖ Conductivity cell its construction and care ❖ Applications in Neutralisation Titrimetry with respect to (a)Strong Acid-Strong Base	Chalk & Board
10	10 Week	(ii) Conductometry: Applications in Neutralisation Titrimetry with respect to (a) Strong Acid-Weak Base (b) Strong Base-weak Acid (c) Weak Acid- Weak Base. Advantages & limitations of conductometric titrations.	Chalk & Board
11	11 Week	**Unit III:** Statistical Treatment of analytical data –II Nature of Indeterminate Errors: ❖ The true and acceptable value of a result of analysis ❖ Measures of central tendency: mean, median, mode, average Measures of dispersion: Absolute deviation, relative deviation, relative average deviation, standard deviation,(s,sigma) variance, coefficient of variation	Chalk & Board

12	12 Week	Distribution of random errors: ❖ Gaussian distribution curve. ❖ Equation and salient features of Gaussian distribution curve	Chalk & Board
13	13 Week	Concept of Confidence limits and confidence interval and its computation using ❖ Population standard deviation ❖ Student's t test ❖ Range	Chalk & Board
14	14 Week	Criteria for rejection of doubtful result ❖ 2.5 d rule ❖ 4.0 d rule ❖ Q test Test of Significance ❖ Null hypothesis ❖ F-test (variance ratio test)	Chalk & Board
15	15 Week	❖ Graphical representation of data and obtaining best fitting straight line (a) For line passing through origin (b) For line not passing through origin ❖ Numerical problems	Chalk & Board

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S.Y.B.Sc. Sem-IV | Paper I | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 :** (a) Solid State ❖ Recapitulation of laws of crystallography and types of crystals ❖ Characteristics of simple cubic, face centered cubic and body centered cubic systems, ❖ Interplanar distance in cubic lattice	Chalk & Board
2.	2 Week	❖ Use of X-rays in the study of crystal structure, ❖ Bragg's equation with derivation ❖ X-rays diffraction method of studying crystal lattice structure, structure of NaCl and KCl. ❖ Determination of Avogadro's number ❖ Numericals	Chalk & Board
3.	3 Week	**(b)** Catalysis: ❖ Types of catalysis, ❖ Catalytic activity, ❖ Specificity and selectivity, ❖ Inhibitors, ❖ Catalyst poisoning and ❖ Deactivation	Chalk & Board
4.	4 Week	**(b) Catalysis:** ❖ Mechanisms and kinetics of acid-base catalyzed reactions, ❖ effect of pH.	Chalk & Board
5.	5 Week	**(b) Catalysis:** ❖ Mechanisms and kinetics of enzyme catalyzed reactions (Michaelis-Menten equation) ❖ Effect of particle size and efficiency of nanoparticles as catalyst.	Chalk & Board
6.	6 Week	**Unit II: Ions in aqeous medium** ❖ Acidity of Cations and Basicity of Anions ❖ Hydration of Cations; Hydrolysis of Cations predicting degree of hydrolysis of Cations-effect of Charge and Radious.	Chalk & Board
7.	7 Week	❖ Latimer Equation. ❖ Relationship between pKa, ❖ Acidity and z^2/r ratios of metal ions graphical Presentation	Chalk & Board

7	8 Week	❖ Classification of cations on the basis of acidity category – ❖ Non acidic, ❖ Moderately acidic, ❖ Strongly acidic, ❖ very strongly acidic with pKa values range and examples	Chalk & Board
8	9 Week	❖ Hydration of Anions; ❖ Effect of Charge and Radius; ❖ Hydration of anions- concept, ❖ Diagram classification on the basis of basicity	Chalk & Board
9	10 Week	❖ Uses and Environmental Chemistry of volatile Oxides and oxo-acids ❖ Physical properties of concentrated oxo-acids like sulfuric, Nitric and Phosphoric acid ❖ Uses and environments aspects of these acids	Chalk & Board
10	11 Week	**Unit III Nitrogen containing compounds and heterocyclic compounds:** **(a) Amines:** ❖ Nomenclature, effect of substituent on basicity of aliphatic and aromatic amines; ❖ Preparation: Reduction ofaromaticnitro compounds using catalytic hydrogenation,chemical reduction using Fe-HCl, Sn-HCl, Zn-acetic acid, reduction of nitriles, ammonolysis of halides, reductive amination , Hofmann bromamide reaction.	Chalk & Board
11	12 Week	❖ Reactions- Salt Formation, N-acylation, N-alkylation, ❖ Hofmann's exhaustive methylation (HEM), ❖ Hofmann-elimination reaction, reaction with nitrous acid, carbylamine reaction, ❖ Electrophilic substitution in aromatic amines: bromination, nitration and sulphonation.	Chalk & Board
12	13 Week	**(b) Diazonium Salts:** ❖ Preparation and their reactions/synthetic application - Sandmeyer reaction, Gattermann reaction, Gomberg reaction, Replacement of diazo group by -H,-OH. ❖ Azo coupling with phenols, naphthols and aromatic amines, reduction of diazonium salt to aryl hydrazine and hydroazobenzene.	Chalk & Board
13	14 eek	**(c) Heterocyclic Compounds:** ❖ Classification, nomenclature, electronic structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; ❖ Synthesis of Furan, Pyrrole (Paal-Knorr synthesis, Knorr	Chalk & Board

		pyrrole synthesis, and Hantzsch synthesis). Thiophene, Pyridine (Hantzsch synthesis), ❖ Reactivity of furan, pyrrole and thiophene towards electrophilic substitution reactions on the basis of stability of intermediate and of pyridine on the basis of electron distribution. ❖ Reactivity of pyridine towards nucleophilic substitution on the basis of electron distribution.	
15	15 Week	❖ Reactions of furan, pyrrole and thiophene: halogenation, nitration, sulphonation, Vilsmeier-Haack reaction, Friedel-Crafts reaction. ❖ Furan: Diels-Alder reaction, Ring opening. ❖ Pyrrole: Acidity and basicity of pyrrole. ❖ Comparison of basicity of pyrrole and pyrrolidine. ❖ Pyridine: Basicity. Comparison of basicity of pyridine, pyrrole and piperidine. ❖ Sulphonation of pyridine, reduction and action of sodamide Chichibabin reaction.	Chalk & Board

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S.Y.B.Sc. Sem-IV | Paper I | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : (a)** Electrochemistry-II ❖ Electrochemical conventions, Reversible and irreversible cells. ❖ Nernst equation and its importance, Types of electrodes, Standard electrode potential, Electrochemical series ❖ Numericals	Chalk & Board
2.	2 Week	**(a)** Electrochemistry-II ❖ Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. ❖ Calculation of equilibrium constant from EMF data. ❖ Numericals	Chalk & Board
3.	3 Week	**(a)** Electrochemistry-II ❖ Concentration cells with transference and without transference. Liquid junction potential and salt bridge. ❖ pH determination using hydrogen electrode and quinhydrone electrode. ❖ Numericals	Chalk & Board
4.	4 Week	(b) 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. ❖ Numericals	Chalk & Board
5.	5 Week	(b) Phase Equilibria: ❖ Phase diagrams of one-component systems (water and sulphur. ❖ Two component systems involving eutectics, congruent and incongruent melting points (lead-silver system).	Chalk & Board
6.	6 Week	**Unit II: Comparative Chemistry of the transition metals** ❖ Position in the periodic table; Natural occurrence principal ores and minerals; ❖ Significance of special stability of d0, d5 and d10 leading to variable oxidation states; Unusual oxidation states and their stabilities in aqueous solutions (with special reference to vanadium, and chromium.)	Chalk & Board

7.	7 Week	❖ Origin of colour for transition metals and their compounds: such as reflectivity, surface coatings, particle size, packing density for metals and nature of d-orbitals, number of electrons in the d-orbitals, geometry, and ability for charge transfer). ❖ Magnetic properties of transition metal compounds: Origin of magnetism-spin and orbital motion of electrons; equation for spin only and spin-orbital magnetism in terms of Bohr magnetons. ❖ Reasons for quenching of orbital moments.	Chalk & Board
7	8 Week	❖ Chemistry of Titanium and vanadium: properties of Oxides and chlorides; use in titrimetric analysis Qualitative tests for transition metal ions: ❖ General considerations in devising tests (with reference to Chromium, Manganese, iron, Cobalt Nickel and Copper)	Chalk & Board
8	9 Week	**(b) Coordination Chemistry** **Introduction to Chemistry of Coordination Compounds** ❖ Historical perspectives: Early ideas on coordination compounds ❖ Basic terms and nomenclature. ❖ Types of ligands ❖ Isomerism :General Types with special reference to stereoisomerism of coordination compounds (C.N=6) ❖ Evidence for the formation of coordination compounds **Theories of coordination compounds** ❖ Werner's Theory of coordination compounds, ❖ Effective atomic number rule. ❖ Eighteen electron Rule	Chalk & Board
9	10 Week	**Nature of the Metal-Ligand Bond:** ❖ Valence Bond Theory; Hybridisation of the central metal orbitals-sp3, sd3/d3s sp3d2/d2sp3, sp2d, ❖ Inner and outer orbital complexes of .(suitable examples of Mn(II) Fe(II),Fe(III),Co(II)/Co(III),Ni(II), Cu(II) Zn(II) complexes with ligands like aqua, ammonia CN- and halides may be used) ❖ Limitations of V.B.T ❖ Application of coordination compounds.	Chalk & Board
10	11 Week	**Unit III Carboxylic Acids and their Derivatives** ❖ Nomenclature, ❖ structure and physical properties, ❖ acidity of carboxylic acids, ❖ effects of substituents on acid strength of aliphatic and aromatic carboxylic acids.	Chalk & Board

11	12 Week	❖ Preparation of carboxylic acids: ❖ oxidation of alcohols and alkyl benzene, ❖ carbonation of Grignard and ❖ hydrolysis of nitriles.	Chalk & Board
12	13 Week	❖ Reactions: Acidity, salt formation, decarboxylation, ❖ Reduction of carboxylic acids with LiAlH4, diborane, ❖ Hell-Volhard-Zelinsky reaction, ❖ Conversion of carboxylic acid to acid chlorides, esters, amides and acid anhydrides and their relative reactivity.	Chalk & Board
13	14 Week	❖ Mechanism of nucleophilic acyl substitution and acid-catalysed nucleophilic acyl substitution. ❖ Interconversion of acid derivatives by nucleophilic acyl substitution. ❖ Mechanism of Claisen condensation and Dieckmann condensation.	Chalk & Board
14	15 Week	**Sulphonic acids:** ❖ Nomenclature, preparation of aromatic sulphonic acids by sulphonation of benzene (with mechanism), toluene and naphthalene, ❖ Reactions: Acidity of arene sulfonic acid, Comparative acidity of carboxylic acid and sulfonic acids, Salt formation, desulphonation. ❖ Reaction with alcohol, phosphorous pentachloride, IPSO substitution.	Chalk & Board

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S.Y.B.Sc. Sem -III | Paper III | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1	1 Week	**Unit 1 : Introduction to Analytical Chemistry and Statistical Treatment of analytical data-I** (a) Role of Analytical Chemistry ❖ Language of analytical chemistry: important terms and their significance in Analytical Chemistry. ❖ Purpose of Chemical Analysis; Analysis Based i. On the nature of information required: (Proximate, Partial, Trace, Complete Analysis)	Chalk & Board
2	2 Week	(b) Role of Analytical Chemistry ❖ Purpose of Chemical Analysis; Analysis Based ii. On the size of the sample used (Macro, semi-micro and micro analysis) ❖ Classical and Non-Classical Methods of Analysis; their types and importance.	Chalk & Board
3	3Week	(c) Significance of Sampling in Analytical Chemistry ❖ Terms involved in Sampling ❖ Types of Sampling ❖ Sampling techniques	Chalk & Board
4	4 Week	(d) Results of Analysis. ❖ Errors in Analysis and their types ❖ Precision and Accuracy in Analysis	Chalk & Board
5	5 Week	(d) Results of Analysis. ❖ Corrections for Determinate Errors ❖ Problems including Numerical	Chalk & Board
6	6 Week	**Unit II Classical Methods of Analysis.** **(a) Titrimetric Methods** ❖ Terms involved in Titrimetric methods of analysis. Comparing volumetry and Titrimetry ❖ The Conditions suitable for titrimetry ❖ Types of titrimetry – Neutralisation (Acidimetry, alkalimetry), Redox, (Iodometry, Iodimetry,) Precipitation and Complexometric titrations and indicators used in these titrations ❖ Tools of Titrimetry: Graduated glasswares and Callibration	Chalk & Board

7	7 Week	**(b) Titrimetric Methods** ❖ 8Standard solutions (Primary and Secondary standards in T9itrimetry) and Calculations in Titrimetry. **(c) Neutralisation Titrations** ❖ Concept of pH and its importance in Neutralisation Titrations ❖ End point and Equivalence point of Neutralisation titrations	Chalk & Board
8	8 Week	**(c) Neutralisation Titrations** ❖ Determination of End point by using i. Indicators causing colour change ii. Change in potential, (by potentiometry) iii. Change in conductance (by conductometry)	Chalk & Board
9	9 Week	**(c) Neutralisation Titrations** ❖ Construction of titration curve (on the basis of change in pH)of a titration of i. Strong acid-weak base ii. Strong base-weak acid **(d) Gravimetric analysis** ❖ General Introduction to Gravimetry. ❖ Types of Gravimetric Methods	Chalk & Board
10	10 Week	**(d) Gravimetric analysis** ❖ Precipitation Gravimetry: 1) Steps involved in precipitation gravimetry analysis 2) Conditions for precipitation 3) Completion of precipitation, 4) Role of Digestion, Filtration, Washing, Drying Ignition of precipitate. 5) Applications of Gravimetric Analysis: Determination of sulfur in organic compounds; Estimation of Nickel in Cu-Ni alloy using dimethyl glyoxime; Determination of Aluminum by converting it to its oxide.	Chalk & Board
11	11 Week	**Unit III: Instrumental Methods-I** **(a) Basic Concepts in Instrumental methods** ❖ Relation between the Analyte, Stimulus and measurement of change in the observable property. ❖ Block Diagram of an Analytical instrument. ❖ Types of Analytical Instrumental methods based on 1) Optical interactions (eg. Spectrometry: uv-visible, Polarimetry) 2) Electrochemical interactions (eg. Potentiometry, Conductometry,) 3) Thermal interactions (eg. Thermogravimetry)	Chalk & Board

12	12 Week	**(b) Spectrometry** ❖ Interaction of electromagnetic radiation with matter: Absorption and Emission spectroscopy. ❖ Basic Terms: Radiant Power, Absorbance, Transmittance, Monochromatic light, Polychromatic light, Wavelength of maximum absorbance, Absorptivity and Molar Absorbtivity.	Chalk & Board
13	13 Week	**(b) Spectrometry** ❖ Statement of Beer's Law and Lambert's Law, Combined Mathematical Expression of Beer -Lambert's Law, Validity of Beer-Lambert's Law, Deviations from Beer-Lambert's Law ((Real deviations, Instrumental deviations and Chemical deviations) (Numerical problems based on Beer-Lambert's Law) ❖ Instrumentation for absorption spectroscopy: Colorimeters and Spectrophotometers	Chalk & Board
14	14 Week	**(b) Spectrometry** ❖ Block Diagrams for Single beam and Colorimeter, and Spectrophotometer (Principles, Construction and working-Details of Components expected i.e , source ,Sample holder , Filters/Monochromators, Detectors such as Photomultiplier tube) ❖ Applications of UV-Visible Spectrophotometry ▫ Qualitative analysis such as Identification of functional groups in Organic compounds Chromophores and Auxochrome,cis and trans isomers ▫ Quantitative analysis by Calibration curve method and	Chalk & Board
15	15 Week	**Photometric Titrations:** ❖ Principle , ❖ Instrumentation, ❖ Types of Photometric titration Curves with examples.	Chalk & Board

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T.Y.B.Sc. Sem-V | Paper I | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit I : (a) Colligative Properties of Dilute Solutions** ❖ Dilute solution, colligate properties, Raoult's law, relative lowering of vapour pressure. ❖ Elevation in boiling point of a solution, thermodynamic derivation relating elevation in the boiling point of a solution and the molar mass of the non-volatile solute.	Chalk & Board
2.	2 Week	**(a) Colligative Properties of Dilute Solutions** ❖ Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute. ❖ Osmotic pressure, van't Hoff's equation for osmotic pressure, (derivation is expected) and determination of molar mass of the solute. ❖ Abnormal molar masses of solutes and van't Hoff factor (calculation of Degree of Association and Degree of Dissociation.)	Chalk & Board
3.	3 Week	**(b) Phase Rule** ❖ Gibb's phase rule and terms involved in the equation. ❖ Application of phase rule to ONE component systems (i) water system, (ii) sulphur system	Chalk & Board
4.	4 Week	**(b) Phase Rule** ❖ Application of phase rule to TWO component systems, condensed systems, condensed phase rule, eutectic systems (Lead-Silver system), desilverisation of lead. ❖ Introduction to three component system, explanation of phase diagram for three liquids forming one immiscible pair.	Chalk & Board
5	5 Week	**Unit II: Surface Chemistry & Catalysis** **(a) Adsorption:** ❖ Physical and Chemical Adsorption, types of adsorption isotherms. ❖ Langmuir's adsorption isotherm (Postulates and derivation	Chalk & Board

		expected). ❖ B.E.T. equation for multilayer adsorption, (derivation not expected). ❖ significance of the terms involved in the equation is expected.),determination of surface area of an adsorbent using B.E.T. equation. Numericals on surface area determination are expected.	
6	6 Week	**(b) Catalysis:** ❖ Homogeneous and heterogeneous catalysis, catalytic activity and selectivity, promoters, inhibitors, catalyst poisoning and deactivation, ❖ Acid-Base catalysis: mechanism and kinetics of acid-base catalyzed reactions, effect of pH on acid-base catalyzed reactions. ❖ Mechanism and kinetics of enzyme catalyzed reaction (Michaelis-Menten equation)	Chalk & Board
7	7 Week	**(c) Colloids** ❖ Introduction to colloidal state of matter. ❖ Origin of charge on colloidal particles. ❖ Concept of electrical double layer, zeta potential, Helmholtz and Stern model, Electro-kinetic phenomena: 1.Electrophoresis,	Chalk & Board
8	8 Week	**(c) Colloids** 2. Streaming potential 3. Sedimentation potential . ❖ Colloidal electrolytes. ❖ Donnan Membrane Equilibrium. ❖ Surfactants, micelle formation, applications of surfactants in detergents, food industry, in pesticide formulations.	Chalk & Board
9	9 Week	**Unit III : Electrochemistry – Electrochemical cells** ❖ Lewis concept of Activity and Activity coefficient, ❖ Mean ionic activity and mean ionic activity coefficient $\gamma_{\pm}$ of an electrolyte, ❖ Expression for activities of electrolytes of different valence type, ionic strength	Chalk & Board
10	10 Week	**Classification of cells**: 1. Chemical cells without transference 2. Concentration cells with and without transference	Chalk & Board

		(derivations of expression for concentration cell EMF are expected) ❖ Origin of liquid-liquid junction potential and its elimination using a salt bridge.	
11	11 Week	Applications of EMF .measurements in the determination of 1. pH of a solution using quinhydrone and glass electrode. 2. Solubility and solubility product of sparingly soluble salts using chemical cell and concentration cell method 3. Determination of liquid-liquid junction potential.	Chalk & Board
12	12 Week	❖ Introduction to Polymers ❖ Basic terms: macromolecule, monomer, repeat unit, degree of polymerization. ❖ Classification of polymers based on 1. Source, 2. Structure, 3. Thermal response, 4. Physical properties.	Chalk & Board
13	13 Week	❖ Molar masses of polymers: 1. Number average molar mass, 2. 2.Weight average molar mass, 3. Viscosity average molar mass, Monodispersity, Polydispersity. ❖ Methods of determining molar masses of polymers : 1. Ultrcentrifuge method (Limiting velocity method only) ❖ Viscosity method Mark-Houwink equation).	Chalk & Board
14	14 Week	❖ Introduction to light emmiting polymers a) Characteristics, b) Method of preparation and c) Application.	Chalk & Board
15	15 Week	**Crystalline State** **Laws of Crystallography** ❖ Characteristics of simple cubic, face centered and body centered cubic system, ❖ Inter planar distance in cubic lattices (only expressions for ratios of inter planar distances).	Chalk & Board

16	16 Week	**Laws of Crystallography** ❖ Use of X- rays in the study of crystal structure, Bragg's equation (derivation expected), X- ray diffraction method of studying crystal lattices, structure of NaCl and KCl, determination of Avagadro number. ❖ Elementary idea of defects in crystals- Frenkel defect and Schottky defect.	

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T.Y.B.Sc. Sem-V | Paper II | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit I : Chemical Bonding And Solid State Chemistry** **Molecular Symmetry** ❖ Molecular Symmetry ❖ Introduction and Importance. ❖ Symmetry elements and symmetry operations.	Chalk & Board
2.	2 Week	**Molecular Symmetry** ❖ Concept of a Point Group with illustrations using the following point gro ups: (i) Cαv (HCl), (ii) Duh (H_2), (iii) C_2v (H_2O), (iv) C_3v (NH_3), (v) C_2h (trans – trichloroethylene), and (vi) D_3h (BCl_3).	Chalk & Board
3.	3 Week	**Molecular Orbital Theory for Polyatomic Species** ❖ Simple triatomic species: H_3^+ and H_3 (correlation between bond angle and Molecular orbitals) ❖ Term such as Walsh correlation diagram, Symmetry Adapted Linear Combinations (SALCs), Ligand Group orbitals (LGOs), transformation of atomic orbitals into appropriate symmetry types, expected to be discussed	Chalk & Board
4.	4 Week	❖ Other molecules (considering only σ-bonding): i) BeH_2, ii) H_2O, ❖ Explanation of terms viz. crystal lattice, lattice points, unit cells and lattice constants.	Chalk & Board
5	5 Week	**Unit II: Solid Materials** ❖ Structures of Solids ❖ Importance of solid state chemistry ❖ Classification of solids on the basis of bonding.	Chalk & Board
6	6 Week	❖ Closest packing of rigid spheres (hcp, ccp), packing density in simple cubic, bcc, fcc and hcp lattices (numerical problems expected). ❖ Point defects with respect to Frenkel and Schottky defects expected	Chalk & Board

7	7 Week	❖ Structure metallic solids. ❖ Tetrahedral and octahedral interstitial voids in ccp lattice, tetrahedral holes, limiting radius ratios for different coordination numbers and their significance, calculation of limiting radius ratio for coordination number 4 ❖ Structures of sodium chloride and cesium chloride.	Chalk & Board
8	8 Week	**Superconductivity** ❖ Superconductivity, Meissner effect. ❖ Different superconducting materials viz,convential superconductors, organic superconductors, alkali metal fullerides (A3C60) and high temperature Superconductors. ❖ Applications of superconducting materials.	Chalk & Board
9	9 Week	**Unit III : Chemistry of elements** (a) Inner transition elements ❖ Introduction: position of f-block elements and comparison between lanthanides and actinides. ❖ The shapes of f-orbitals.	Chalk & Board
10	10 Week	(b) Lanthanides Series ❖ Chemistry of lanthanides with reference to (i) lanthanide contraction, (ii) Oxidation states (iii) Magnetic and spectral properties.	Chalk & Board
11	11 Week	❖ Occurrence, extraction and separation of lanthanides by Solvent extraction. ❖ Applications of lanthanides.	Chalk & Board
12	12 Week	(c) Actinides Series ❖ Chemistry of Uranium and with reference to occurrence, extraction (solvent extraction method). ❖ Properties and applications.	Chalk & Board
13	13 Week	**Unit VI Solution Chemistry** (a) Acid-base Chemistry in Aqueous Medium ❖ Acidity of mono- and polyatomic anions to Include Latimer equation and IV predominance diagrams	Chalk & Board

14	14 Week	(a) Acid-base Chemistry in Aqueous Medium ❖ Basicity of mono- and polyatomic anions to Include Latimer equation and IV predominance diagrams	Chalk & Board
15	15 Week	(b) Chemistry in Non-aqueous Solvents ❖ Classification of solvents and importance of non-aqueous solvents. ❖ Characteristics and study of liquid ammonia as non-aqueous solvents with respect to (i) acid-base reactions and (ii) redox reactions.	Chalk & Board
16	16 Week	(b) Chemistry in Non-aqueous Solvents ❖ Characteristics and study of dinitrogen tetraoxide and acetic acid as non-aqueous solvents with respect to (i) acid-base reactions and (ii) redox reactions.	

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T.Y.B.Sc. Sem-V | Paper III | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : Mechanism of Organic Reactions** ❖ Thermodynamic and Kinetic control of organic reactions: ❖ Concept with mechanisms of the following reactions: 1) Addition of HX to butadiene; 2) Sulfonation of naphthalene. ❖ Nucleophilicity/ electrophilicity vs Basicity/acidity.	Chalk & Board
2.	2 Week	❖ Mechanism of elimination reactions, with stereochemistry: E_1 and E_2 reactions: regioselectivity (Saytzeff and Hofmann rules). ❖ Mechanism of reactions of carbonyl compounds with nucleophiles: Formation of acetals/ketals from aldehydes and ketones. ❖ Reaction of aldehydes and ketones with primary and secondary amines	Chalk & Board
3.	3 Week	❖ Acyl nucleophilic substitution (tetrahedral mechanism): Acid catalysed esterification of Carboxylic acids and base promoted hydrolysis of esters. ❖ Mechanism of rearrangements with examples and stereochemistry wherever applicable. ❖ Migration to electron deficient carbon: Pinacol, Benzylic acid.	Chalk & Board
4.	4 Week	❖ Mechanism of rearrangements with examples and stereochemistry wherever applicable ❖ Migration to electron deficient nitrogen: 1) Beckmann, 2) Hofmann. ❖ Mechanism of the following reactons with synthetic application: 1) Claisen condensation and 2) Michael addition.	Chalk & Board
5.	5 Week	**Unit II: Stereochemistry** ❖ Molecular chirality and element of symmetry: Mirror Plane symmetry (inversion centre), rotation-reflection (altemating) axis, ❖ Chirality of compounds without stereogenic centre: 1) Cummulenes, 2) Spirans and 3) Biphenyls.	Chalk & Board

6.	6 Week	❖ Stability ofcycloalkanes: Strains in cycloalkanes-angle,eclipising, transannular (3 to 8 membered). ❖ Conformations of cyclohexane, mono- and di- alkyl cyclohexanes and their relative stabilities. ❖ Stereo selectivity and Stereo specificity: Idea of enantioselectivity (ee) and diastereoselectivity (de). ❖ Topicity-enantiotopic and diastereotopic atoms, groups and faces.	Chalk & Board
7.	7 Week	❖ Stereochemistry of- (1) Substitution reactions- SN^1, SN^2, SN^i (reaction of alcohol with thionyl chloride). (2) E_3-anti-elimination-Base induced dehydrohalogenation of 1- bromo-1,2- diphenylpropane.	Chalk & Board
7	8 Week	❖ Stereochemistry of- Addition reactions to olefins- (1) Catalytic hydrogenation (2) Bromination (electrophilic anti addition) (3) Syn- hydroxylation (molecular addition) with OsO4 and KMnO4.	Chalk & Board
9	9 Week	**Unit III: Carbohydrates** ❖ Introduction: Classification, Sources, Reducing and non-reducing sugars DL notation. ❖ Structures of monosaccharides: Fischer projection (4-6 carbon III monosaccharides and Haworth formula-Furanose and pyranose forms of pentoses and hexoses. Interconversion :open and Haworth forms of monosaccharides with 5 and 6 carbons. ❖ Chair conformation with stereochemistry of D-glucose and D- fructose. Stability of chair forms of D- glucose.	Chalk & Board
10	10 Week	❖ Determination of open chain configuration- of D-glucose assuming the configuration of D-arabinose; and of D-fructose assuming the configuration of D-glucose. ❖ Anomers and epimers of monosaccharides. Enantiomers and diastereomers of glucose. Mutarotation (with mechanism) in D-glucose.Chain lengthening and shortening reaction: Modified kiliani-fischer synthesis. Wohl method.	Chalk & Board
11	11 Week	❖ Reactions of D-glucose and D fructose: o osazone formation o reduction- H2/Ni, NaBH4 o oxidation bromine water, HNO3, HIO4. o interconversion of D-glucose and D-fructose o acetylation o methylation [e and f with cyclic pyranose form]. ❖ Commercial importance of carbohydrates in pharmaceutical, paper,food and Textile industries.	Chalk & Board

12	12 Week	❖ IUPAC systematic and accepted trivial nomenclature of the following classes of compounds, including substituted ones (up to 2 substituents/functional groups): (1) Bicyclic compounds- spiro- ,fused, and bridged (upto 11carbon atoms)-saturated and unsaturated compounds. (2) Biphenyls. (3) Cummulenes upto 3 double bonds (4) Monocyclic (5 and 6 membered) aromatic and non-aromatic heterocyclic compounds containing a maximum of two hetero atoms among N,O,S.	Chalk & Board
13	13 Week	**Unit IV: (a) Heterocyclic Chemistry** ❖ Introduction: Electronic structure and aromaticity of furan, pyrrole,thiophene and pyridine. ❖ Synthesis: Synthesis of furans, l pyrroles, and thiophenes by Paal-Knor synthesis. Pyridines by Hantzsch synthesis and from 1,5-diketones. ❖ Reactivity: Reactivity towards electrophilic substitution reactions- of furan, pyrrole and thiophene on basis of stability of intermediate; and of pyridine on the basis of electron distribution. ❖ Nucleophilic substitution reaction of pyridine on the basis of electron distribution.	Chalk & Board
14	14 Week	❖ Reactions of heterocycles: The following reactions of furan, pyrrole and thiophene: Halogenation , Nitration, Sulphonation, Vilsmeir formylation reaction, Friedel-Crafts reaction. ❖ Furan: Diels-Alder reaction. Ring opening of furan. ❖ Pyrrole: Acidity and basicity of pyrrole -Comparison of basicity of pyrrole and pyrrolidine, Acid catalyzed polymerization of pyrrole. ❖ Pyridine: Basicity. Comparison of basicity of pyridine, pyrrole and piperidine. Sulphonation of pyridine, with and without catalyst. Reduction.Oxidation of alkyl pyridines and action of sodamide (Chichibabin reaction).N methylation of pyridine. ❖ Quaternization of piperdine, pyrrolidine and Hofmann elimination of the quaternary salts.	Chalk & Board
15	15 Week	**(b)Organic Synthesis** ❖ Introduction: Criteria for ideal organic synthesis. Yield and selectivity. ❖ Multi- component synthesis – with examples, Mannich reaction, Hanztsch synthesis of pyridines (without mechanism). ❖ Illustrative synthesis of industrially important compounds: Ibuprofen (chiral synthesis), paracetamol (green synthesis), L ascorbic acid (from D-glucose), norfloxacin,	Chalk & Board

16		❖ Illustrative synthesis of industrially important compounds: thyroxine, vanillin, methyl dihydrojasmonate (Hedione), Bifenox-I, pigment red 242, indigo, 2 hydroxy-3-amino-5-nitrobenzene sulphonic acid ❖ Newer methods of organic synthesis: Introduction to the use of the following in organic synthesis: Ultrasound, microwaves, PTC.	

Name of the Teacher

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T.Y.B.Sc. Sem-V | Paper IV | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	❖ **Unit 1 : Treatment of analytical data-I and sampling** ❖ **Treatment of Analytical Data** a) Types of errors, b) Determinate and indeterminate errors, c) Minimization of errors, d) Constant and proportionate errors, e) Accuracy and precision,	Chalk & Board
2.	2 Week	❖ **Treatment of Analytical Data** ❖ Measures Of Dispersion And Central Tendency: a) Mean, b) Median, c) Average Deviation, d) Relative Average Deviation, e) Standard Deviation, f) Variance, g) Coefficient of Variation. h) Numerical	Chalk & Board
3.	3 Week	❖ **Sampling** ❖ Terms involved, importance of sampling, ❖ Sampling techniques. ❖ Sampling of gases, a) Ambient and stack sampling, b) Equipment used, c) Sampling of homogeneous and heterogeneous liquids, d) Sampling of static and flowing liquids, e) Methods and equipments used.	Chalk & Board
4.	4 Week	❖ **Sampling** ❖ Sampling of solids, a) Importance of particle size and sample size, b) Samples used, c) Need for the reduction in the sample size, d) Methods of reduction in sample size, e) Collection, f) Preservation and dissolution of the sample.	Chalk & Board

5.	5 Week	**Unit II: Titrimetric analysis-I and UV- Visible spectroscopy.** ❖ Acid-base Titrations ❖ Construction of titration curves and choice of indicators in the titration of [1] strong acid and strong base, [2] strong acid and weak base,	Chalk & Board
6.	6 Week	❖ Construction of titration curves and choice of indicators in the titration of [3] weak acid and strong base, [4] weak acid and weak base.	Chalk & Board
7.	7 Week	❖ Precipitation titrations ❖ Argentimetric titrations, ❖ construction of the titration curve, ❖ Volhard's method, Mohr's method, ❖ Adsorption indicators, ❖ Theory and applications.	Chalk & Board
7	8 Week	**Visible Spectroscopy** ❖ Photometers and spectrophotometers, ❖ Instrumentation in the case of single and double beam spectrophotometers, ❖ Qualitative and quantitative analysis, calibration cure method.	Chalk & Board
8	9 Week	**Unit III Methods of separation-I** **Solvent Extraction** a) Partition Coefficient And Distribution Ratio, b) Extraction Efficiency, c) Separation Factor, d) Role Of Complexing Agents In Solvent Extraction	Chalk & Board
9	10 Week	**Solvent Extraction** ❖ Chelation ❖ Ion Pair Formation ❖ Solvation ❖ Types Of Solvent Iii Extraction: [1] Batch, [2] Continuous.	Chalk & Board

10	11 Week	**Chromatography** ❖ Introduction to chromatographic techniques, ❖ Classification of chromatographic techniques.	Chalk & Board
11	12 Week	**Planar Chromatography** ❖ Principle, ❖ techniques and applications of [1] Paper chromatography [2] Thin layer chromatography	Chalk & Board
12	13 Week	**Unit IV:** Optical methods Atomic Spectroscopy ❖ Absorption and emission spectra, ❖ Energy level diagrams, ❖ Process involved in atomization, ❖ Flame photometry, ❖ Flame atomizer, ❖ Types of burners, ❖ monochromators and detectors, ❖ atomic absorption spectroscopy;	Chalk & Board
13	14 Week	❖ Flame and Electrothermal Atomizer, ❖ Sources, ❖ Instrumentation, ❖ Quantitative Applications Of Atomic Absorption And Flame Photometry, ❖ Calibration Curve Method, Standard Addition And Internal Standard Method	Chalk & Board
14	15 Week	**Molecular Fluorescence and Phosphorescence Spectroscopy** ❖ Theory, ❖ Instrumentation and ❖ Applications	Chalk & Board
15	16 Week	**Turbidimetry and Nephelometry** ❖ Scattering of light, ❖ Effect of concentration, ❖ Particle size and wavelength on light scattering, Instrumentation and applications.	

Name of the Teacher

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Department of Chemistry

M.Sc. Part II | Organic Chemistry P-I | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : Organic reaction mechanisms** ➢ Organic reactive intermediates, methods of generation, structure, stability and important reactions involving carbocations, nitrenes, carbenes, arynes and ketenes.	Chalk and Board
2.	2 Week	➢ Organic reactive intermediates, methods of generation, structure, stability and important reactions ketenes. ➢ Neighbouring group participation: Mechanism and effects of anchimeric assistance, NGP by unshared/ lone pair electrons, π-electrons, aromatic rings, σ-bonds with special reference to norbornyl and bicyclo[2.2.2]octyl cation systems (formation of non-classical carbocation)	Chalk and Board
3.	3 Week	➢ Role of FMOs in organic reactivity: Reactions involving hard and soft electrophiles and nucleophiles, ambident nucleophiles, ambident electrophiles, the α effect. ➢ Pericyclic reactions: Classification of pericyclic reactions; thermal and photochemical reactions. ➢ Three approaches: Evidence for the concertedness of bond making and breaking	Chalk and Board
4.	4 Week	➢ Evidence for the concertedness of bond making and breaking Symmetry-Allowed and Symmetry-Forbidden Reactions – The Woodward-Hoffmann Rules-Class by Class 1. The generalised Woodward-Hoffmann Rule 2. Explanations for Woodward-Hoffmann Rules The Aromatic Transition structures [Huckel and Mobius] 3. Frontier Orbitals 4. Correlation Diagrams, FMO and PMO approach 5. • Molecular orbital symmetry, Frontier orbital of ethylene, 1,3 butadiene, 1,3,5 hexatriene and allyl system.	Chalk and Board

5.	5 Week	**Unit II : Pericyclic reactions** ➢ Cycloaddition reactions: Supra and antra facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes. ➢ Diels-Alder reactions, 1, 3-Dipolar cycloaddition and cheletropic reactions, ene reaction, retro-Diels-Alder reaction, regioselectivity, periselectivity, torquoselectivity, site selectivity and effect of substituents in Diels-Alder reactions.	Chalk and Board
6.	6 Week	➢ Other Cycloaddition Reactions- [4+6] Cycloadditions, Ketene Cycloaddition, Allene Cycloadditions, Carbene Cycloaddition, Epoxidation and Related Cycloadditions. ➢ Other Pericyclic reactions: Sigmatropic Rearrangements, Electrocyclic Reactions, Alder 'Ene' Reactions.	Chalk and Board
7.	7 Week	➢ Electrocyclic reactions: Conrotatory and disrotatary motions, 4nπ and (4n+2)π electron and allyl systems. ➢ Sigmatropic rearrangements: H-shifts supra and antarafacial migrations, retention and inversion of configurations.	Chalk and Board
8.	8 Week	➢ Sigmatropic rearrangements: C-shifts, supra and antarafacial migrations, retention and inversion of configurations.migrations, retention and inversion of configurations. ➢ Cope (including oxy Cope and aza-Cope) and Claisen rearrangements. ➢ Formation of Vitamin D from 7-dehydro cholesterol, synthesis of citral using pericyclic reaction, conversion of Endiandric acid E to Endiandric acid A.	Chalk and Board
9.	9 Week	**Unit III Stereochemistry-I** ➢ Classification of point groups based on symmetry elements with examples (nonmathematical treatment). ➢ Conformational analysis of medium rings: Eight and nine membered rings and their unusual properties, I-strain, transannular reactions.	Chalk and Board

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9	10 Week	➢ Conformational analysis of medium rings: Ten membered rings and their unusual properties, I-strain, transannular reactions. ➢ Stereochemistry of fused ring and bridged ring compounds: decalins, hydrindanes, perhydroanthracenes, steroids, and Bredt's rule.	Chalk and Board
10	11 Week	➢ Anancomeric systems, Effect of conformation on reactivity of cyclohexane derivatives in the following reactions (including mechanism): (1) • Electrophilic addition, • Elimination, • Molecular rearrangements, of cyclohexanones (with LiAlH4, selectride and MPV reduction) and • Oxidation of cyclohexanols.	Chalk and Board
11	12 Week	**Unit IV Photochemistry** ➢ Principles of photochemistry: quantum yield, electronic states and transitions, selection rules, modes of dissipation of energy (Jablonski diagram), electronic energy transfer: photosensitization and quenching process.	Chalk and Board
12	13 Week	➢ Photochemistry of carbonyl compounds:$\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions, ➢ Norrish- Norrish-II cleavages, ➢ Paterno-Buchi reaction.	Chalk and Board
13	14 Week	➢ Photoreduction, calculation of quantum yield, photochemistry of enones, ➢ photochemical rearrangements of α, β-unsaturated ketones and cyclohexadienones ➢ . Photo Fries rearrangement, Barton reaction.	Chalk and Board
14	15 Week	➢ Photochemistry of olefins: cis-trans isomerizations, dimerizations, hydrogen abstraction, addition and Di-π- methane rearrangement including aza-di- π - methane. ➢ Photochemical Cross-Coupling of Alkenes, Photodimerisation of alkenes. ➢ Photochemistry of arenes: 1, 2- , 1, 3- and 1, 4- additions. Photocycloadditions of aromatic Rings. Singlet oxygen and photo-oxygenation reactions. ➢ Photochemically induced Radical Reactions. Chemiluminescence.	Chalk and Board

Name of the Teacher

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Department of Chemistry

M.Sc. Part II | Organic Chemistry (Paper II) | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : Name reactions with mechanism and application** • Mukaiyama esterification, • Mitsonobu reaction, • Darzen's Glycidic Ester syntheis, • Ritter reaction, • Yamaguchi esterification,	Chalk and Board
2.	2 Week	• Peterson olefination. • Domino reactions: Characteristics; Nazerov cyclization	Chalk and Board
3.	3 Week	• Multicomponent reactions: • Strecker Synthesis, • Ugi 4CC, • Biginelli synthesis, • Hantzsch synthesis	Chalk and Board
4.	4 Week	• Multicomponent reactions: Pictet-Spengler synthesis • Click Reactions: Characteristics; Huisgen 1,3-Dipolar Cycloaddition	Chalk and Board
5.	5 Week	**Unit II : Radicals in organic synthesis** ➢ Introduction: Generation, stability, reactivity and structural and stereochemical properties of free radicals, Persistent and charged radicals, Electrophilic and nucleophilic radicals..	Chalk and Board
6.	6 Week	➢ Radical Initiators: azobisisobutyronitrile (AIBN) and dibenzoyl peroxide. ➢ Characteristic reactions - Free radical substitution, addition to multiple bonds. Radical chain reactions, Radical halogenation of hydrocarbons (Regioselectivity), radical cyclizations, autoxidations: synthesis of cumene hydroperoxide from cumene.	Chalk and Board
7.	7 Week	➢ Radicals in synthesis: Inter and intra molecular C-C bond formation via mercuric hydride, tin hydride, thiol donors. Cleavage of C-X, C-Sn, C-Co, C-S, O-O bonds. ➢ Oxidative coupling, C-C bond formation in aromatics: SRNAr reactions.	Chalk and Board

8.	8 Week	➢ Hunsdiecker reaction, ➢ Pinacol coupling, ➢ McMurry coupling, ➢ Sandmeyer reaction, ➢ Acyloin condensation.	Chalk and Board
9.	9 Week	**Unit III Enamines, Ylides and α-C-H functionalization** ➢ Enamines: Generation & application in organic synthesis with mechanistic pathways, Stork enamine reaction. ➢ Reactivity, comparison between enamines and enolates. ➢ Synthetic reactions of enamines including asymmetric reactions of chiral enamines derived from chiral secondary amines.	Chalk and Board
10.	10 Week	➢ **Phosphorus, Sulfur and Nitrogen Ylides**: Preparation and their synthetic applications along with their stereochemical aspects.	Chalk and Board
11.	11 Week	➢ Wittig reaction, ➢ Horner-Wadsworth-Emmons Reaction, ➢ Barton-Kellogg olefination..	Chalk and Board
12.	12 Week	➢ **α-C-H functionalization**: By nitro, sulfoxide, sulfone and phosphonate groups: generation of carbanions by strong bases (LDA/n-butyl lithium) and applications in C-C bond formation. ➢ Bamford-Stevens reaction, ➢ Julia olefination and its modification, ➢ Seyferth–Gilbert homologation, ➢ Steven's rearrangement.	
13.	13 Week	**Unit IV : Metals / Non-metals in organic synthesis** ➢ Mercury in organic synthesis: Mechanism and regiochemistry of oxymercuration and demercuration of alkenes, mercuration of aromatics, transformation of aryl mercurials to aryl halides. ➢ Organomercurials as carbene transfer reagents.	Chalk and Board
14.	14 Week	➢ Organoboron compounds: Mechanism and regiochemistry of hydroboration of alkenes and alkynes, asymmetric hydroboration using chiral boron reagents, 9-BBN hydroboration, oxazaborolidine (CBS catalyst) and functional group reduction by diborane.	Chalk and Board

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15.	15 Week	➢ Organosilicons: Salient features of silicon governing the reactivity of organosilicons, preparation and important bond-forming reactions of alkyl silanes, alkenyl silanes, aryl silanes and allyl silanes. β-silyl cations as intermediates. Iodotrimethylsilane in organic synthesis.	Chalk and Board
16.	16 Week	➢ Silyl enol ethers: Application: As nucleophiles (Michael reaction, Mukaiyama aldol reaction), in ring contraction reactions. ➢ Organotin compounds: Preparation of alkenyl and allyl tin compounds; application in C-C bond formation, in replacement of halogen by H at the same C atom. ➢ Selenium in organic synthesis: Preparation of selenols/selenoxide, selenoxide elimination to create unsaturation, selenoxide and seleno acetals as α-C-H activating groups	Chalk and Board

Name of the Teacher
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Department of Chemistry

M.Sc. Part II | Organic Chemistry (Paper III) | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : Natural products-I** **Carbohydrates:** ❖ Introduction to naturally occurring sugars: Deoxysugars, aminosugars, branched sugars. ❖ Structure elucidation of lactose and D glucosamine (synthesis not expected). ❖ Structural features and applications of inositol, starch, cellulose.	Chalk and Board
2.	2 Week	❖ **Carbohydrates:**Structural features and applications of chitin and heparin. ❖ **Natural pigments:** General structural features, occurrence, biological importance and applications of: a. Carotenoids, b. Anthocyanins, c. Quinones, d. Flavones, e. Pterins and f. Porphyrins (chlorophyll).	Chalk and Board
3.	3 Week	❖ **Natural pigments:** Structure elucidation of β-carotene and Cyanin (with synthesis). ❖ Synthesis of ubiquinone from 3, 4, 5 trimethoxyacetophenone. ❖ **Insect pheromones:** General structural features and importance. ❖ Types of pheromones (aggregation, alarm, releaser, primer, territorial, trail, sex pheromones etc.)	Chalk and Board
4.	4 Week	❖ **Insect pheromones:** advantage of pheromones over conventional pesticides. Synthesis of bombykol from acetylene, disparlure from 6-methylhept-1-ene, grandisol from 2-methyl-1, 3-butadiene. ❖ **Alkaloids:** Occurrence and physiological importance of morphine and atropine. Structure elucidation, spectral data and synthesis of coniine.	Chalk and Board

5.	5 Week	**Unit II : Natural products-II** ❖ Multi-step synthesis of natural products: Synthesis of the following natural products with special reference to reagents used, stereochemistry and functional group transformations: a. Woodward synthesis of Reserpine from benzoquinone b. Corey synthesis of Longifoline from resorcinol c. Gilbert-Stork synthesis of Griseofulvin from phloroglucinol	Chalk and Board
6.	6 Week	❖ Multi-step synthesis of natural products: Synthesis of the following natural products with special reference to reagents used, stereochemistry and functional group transformations: a. Corey's Synthesis of Caryophyllene from 2-Cyclohexenone and Isobutylene b. Synthesis of Juvabione from Limonene c. Synthesis of Taxol.	Chalk and Board
7.	7 Week	❖ **Prostaglandins**: Classification, general structure and biological importance. Structure elucidation of PGE1. ❖ **Lipids**: Classification, role of lipids, Fatty acids and glycerol derived from oils and fats.	Chalk and Board
8.	8 Week	❖ **Insect growth regulators:** General idea, structures of JH_2 and JH_3 . ❖ **Plant growth regulators:** Structural features and applications of arylacetic acids, gibberellic acids and triacontanol. ❖ Synthesis of triacontanol (synthesis of stearyl magnesium bromide and 12-bromo-1 tetrahydropyranyloxydodecane expected).	Chalk and Board
9.	9 Week	**Unit III: Advanced spectroscopic techniques-I** ❖ **Proton NMR spectroscopy:** Recapitulation, chemical and magnetic equivalence of protons, First order, second order, Spin system notations (A2, AB, AX, AB2, AX2, AMX and A2B2-A2X2 spin systems with suitable examples). ❖ Long range coupling (Allylic coupling, 'W' coupling and Coupling in aromatic and heteroaromatic systems)	Chalk and Board
10.	10 Week	❖ **Proton NMR spectroscopy:** Temperature effects, Simplification of complex spectra, nuclear magnetic double resonance, chemical shift reagents.	Chalk and Board

11.	11 Week	❖ **^{13}C –NMR spectroscopy:** Recapitulation, equivalent and non-equivalent carbons (examples of aliphatic and aromatic compounds), ❖ ^{13}C- chemical shifts, calculation of 13C- chemical shifts of aromatic carbons, heteronuclear coupling of carbon to ^{19}F and ^{31}P.	Chalk and Board
12.	12 Week	❖ Spectral problems based on UV, IR, $^{1}HNMR$ and $^{13}CNMR$ and Mass spectroscopy.	Chalk and Board
13.	13 Week	**Unit IV : Advanced spectroscopic techniques-II** ❖ Advanced NMR techniques: DEPT experiment, determining number of attached hydrogens (Methyl/methylene/methine and quaternary carbons ❖ Two dimensional spectroscopic techniques, COSY and HETCOR spectra, NOE and NOESY techniques.	Chalk and Board
14.	14 Week	❖ Spectral problems based on UV, IR, $^{1}HNMR$, $^{13}CNMR$ (Including 2D technique) and Mass spectroscopy.	Chalk & Board, PPT
15.	15 Week	❖ Spectral problems based on UV, IR, $^{1}HNMR$, $^{13}CNMR$ (Including 2D technique) and Mass spectroscopy.	Chalk & Board
16.	16 Week	❖ Spectral problems based on UV, IR, $^{1}HNMR$, $^{13}CNMR$ (Including 2D technique) and Mass spectroscopy.	Chalk & Board

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Department of Chemistry

M.Sc. Part II | Organic Chemistry (Paper IV) | Lecture Plan

Sr. No.	Week	Syllabus Details	Method Used
1.	1 Week	**Unit 1 : Drug discovery, design and development** ❖ Introduction, important terms used in medicinal chemistry: receptor, therapeutic index, bioavailability, drug assay and drug potency. ❖ General idea of factors affecting bioactivity: Resonance, inductive effect, bioisosterism, spatial considerations. ❖ Basic pharmacokinetics: drug absorption, distribution, metabolism (biotransformation) and elimination.	PPT
2.	2 Week	❖ Physical and chemical parameters like solubility, lipophilicity, ionization, pH, redox potential, H-bonding, partition coefficient and isomerism in drug distribution and drug-receptor binding.	PPT
3.	3 Week	❖ Procedures in drug design: Drug discovery without a lead: Penicillin, Librium. ❖ Lead discovery: random screening, non-random (or targeted) screening. ❖ Lead modification: Identification of the pharmacophore, Functional group modification.	PPT
4.	4 Week	❖ Structure-activity relationship, ❖ Structure modification to increase potency and therapeutic index: Homologation, chain branching, ring-chain transformation, bioisosterism, combinatorial synthesis (basic idea).	PPT
5.	5 Week	**Unit II : Drug design, development and synthesis** ❖ Introduction to quantitative structure activity relationship studies. ❖ QSAR parameters: - steric effects: The Taft and other equations; ❖ Methods used to correlate regression parameters with biological activity: ❖ Hansch analysis- A linear multiple regression analysis.	PPT
6.	6 Week	❖ Introduction to modern methods of drug design and synthesis- computer aided molecular graphics based drug design. ❖ Drug design via enzyme inhibition (reversible and irreversible), bioinformatics and drug design.	PPT

7.	7 Week	❖ **Concept of prodrugs and soft drugs.** o Prodrugs: Prodrug design, types of prodrugs, functional groups in prodrugs, advantages of prodrug use. o Soft drugs: concept and properties.	PPT
8.	8 Week	❖ Synthesis and application of the following drugs: Fluoxetine, cetrizine, esomeprazole, fluconazole, zidovudine, methotrexate, diclofenac, labetalol, fenofibrate.	PPT
9.	9 Week	**Unit III: Biogenesis and biosynthesis of natural products** ❖ Primary and secondary metabolites and the building blocks, general pathway of amino acid biosynthesis.	PPT
10.	10 Week	❖ **Acetate pathway**: Biosynthesis of malonylCoA, saturated fatty acids, prostaglandins from arachidonic acid, aromatic polyketides.	PPT
11.	11 Week	❖ **Shikimic Acid pathway**: Biosynthesis of shikimic acid, aromatic amino acids, cinnamic acid and its derivatives, lignin and lignans, benzoic acid and its derivatives, flavonoids and isofalvonoids.	PPT
12.	12 Week	❖ **Mevalonate pathway**: Biosynthesis of mevalonic acid, monoterpenes – geranyl cation and its derivatives, sesquiterpenes – farnesyl cation and its derivatives and diterpenes.	PPT
13.	13 Week	**Unit IV : Green chemistry** ❖ Introduction, basic principles of green chemistry. Designing a green synthesis: Green starting materials, green reagents, green solvents and reaction conditions, green catalysts ❖ Use of the following in green synthesis with suitable examples: a) Green reagents: dimethylcarbonate, polymer supported reagents. b) Green solvents: water, ionic liquids, deep eutectic solvents, supercritical carbon dioxide.	PPT
14.	14 Week	❖ Use of the following in green synthesis with suitable examples: c) Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts, phase transfer catalysts [Aliquat 336, benzyltrimethyl ammonium chloride (TMBA), Tetra-n-butyl ammonium chloride, crown ethers], biocatalysts. d) Solid state reactions: solid phase synthesis, solid supported synthesis	PPT

15.	15 Week	❖ Use of the following in green synthesis with suitable examples: (e) Microwave assisted synthesis: reactions in water, reactions in organic solvents, solvent free reactions. (f) Ultrasound assisted reactions. ❖ Comparison of traditional processes versus green processes in the syntheses of ibuprofen	Chalk & Board
(g)	16 Week	❖ Comparison of traditional processes versus green processes in the syntheses of adipic acid, 4-aminodiphenylamine, p-bromotoluene and benzimidazole. ❖ Green Cataysts : Nanocatalyst, Types of nanoctalysts, Advantages and Disadvantages of Nanocatalysts, Idea of Magnetically separable nanocatalysts.	Chalk & Board

Name of the Teacher

miss Ruqaiya Ansari