Nomenclature of Major Papers in UG (Four-year graduate program)

Chemistry

SEMESTER-I		
S.No.	Course Code	Title
1.	08/CHE/MJR/101T	Inorganic Chemistry-I
2.	08/CHE/MJR/101P	Practical Chemistry
3.	08/CHE/MJR/102T	Organic Chemistry-I
4.	08/CHE/MJR/102P	Practical Chemistry
SEMESTER-II		
1.	08/CHE/MJR/151T	Inorganic Chemistry-II
2.	08/CHE/MJR/151P	Practical Chemistry
3.	08/CHE/MJR/152T	Physical Chemistry-I
4.	08/CHE/MJR/152P	Practical Chemistry
SEMESTER-III		
1.	08/CHE/MJR/201T	Organic Chemistry-II
2.	08/CHE/MJR/201P	Practical Chemistry
3.	08/CHE/MJR/202T	Physical Chemistry-II
4.	08/CHE/MJR/202P	Practical Chemistry
SEMESTER-IV		
1.	08/CHE/MJR/251T	Inorganic Chemistry-III
2.	08/CHE/MJR/251P	Practical Chemistry
3.	08/CHE/MJR/252T	Advanced Chemistry-I
4.	08/CHE/MJR/252P	Practical Chemistry
SEMESTER-V		
1.	08/CHE/MJR/301T	Inorganic Chemistry-IV
2.	08/CHE/MJR/301P	Practical Chemistry
3.	08/CHE/MJR/302T	Physical Chemistry-III
4.	08/CHE/MJR/302P	Practical Chemistry
SEMESTER-VI		
1.	08/CHE/MJR/351T	Organic Chemistry-III
2.	08/CHE/MJR/351P	Practical Chemistry
3.	08/CHE/MJR/352T	Advanced Spectroscopy
4.	08/CHE/MJR/352P	Practical Chemistry
SEMESTER-VII		
1.	08/CHE/MJR/401T	Inorganic Chemistry
2.	08/CHE/MJR/401P	Inorganic Lab
3.	08/CHE/MJR/402T	Organic Chemistry
4.	08/CHE/MJR/402P	Organic Lab
5.	08/CHE/MJR/403T	Physical Chemistry
6.	08/CHE/MJR/403P	Physical Lab
SEMESTER-VIII		
1.	08/CHE/MJR/451T	Advanced Organic Chemistry
2.	08/CHE/MJR/451P	Practical Chemistry
3.	08/CHE/MJR/452T	Analytical Chemistry
4.	08/CHE/MJR/452P	Analytical Lab

SEMESTER-I

Title: Inorganic Chemistry-I

Course Code: (08/CHE/MJR/101T)

UNIT-I:

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy, solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, Fajan's rule, polarizing power and polarizability of ions

UNIT- II:

Ionic Bonding: Structures of ionic solids, radius ratio effect and co-ordination number. Limitations of radius ratio rule. Bond moment, dipole moment and percentage ionic character.

Hydrogen Bonding: Types and impact of inter and intra molecular hydrogen bonding, Vander waal's forces of attractions.

UNIT- III:

Covalent bond: Valence bond theory and its limitation, Directional characteristics of covalent bond, Hybridizations-sp, sp^2, sp^3, dsp^2, sp^3d, dsp^3, sp^3d^2 and d^2sp^3 with suitable examples. Shapes of inorganic molecules and ions.

Valence shell election pair repulsion (VSEPR) theory and its application to study the geometry of NH_3, H_2O, H_3O^+, SF_4, ICl^-_2, ClF_3, ICl^-_4, XeF_4, XeF_6, molecules. Molecular orbital theory and molecular orbital diagrams for homo and hetero-diatomic molecules -H_2, H_2^+, He_2^+, He^+, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, O_2^+, O^-_2, O_2^{2-}, O_2^{2+}, CO and NO.

UNIT-IV:

Molecular Orbital Theory: Molecular Orbital Approach Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p- mixing) and heteronuclear diatomic molecules such as CO, NO and NO', Comparison of VB and MO approaches. Banana Bonding (3C-2e- Bond) in diboranes.

UNIT- V:

Qualitative Analysis: Theoretical basis of qualitative analysis, Systematic analysis of acidic and basic radicals (including interfering radicals). Chemical reactions involved.

Solubility product & their applications, Common- ion effect. Concept and role of interfering anions.

Books Suggested:

1. Shriver & Atkins' Inorganic Chemistry (Oxford University Press)

2. Selected Topics in Inorganic Chemistry by Wahid Malik, G D Tuli and R D Madan (S. Chand)

3. Principles of Inorganic Chemistry by B.R. Puri and L.R. Sharma and K C Kalia (Milestone Publisher and Distributor)

4. Concise inorganic Chemistry by J D Lee (Wiley India Pvt. Ltd.)

5. Practical Chemistry (For B.Sc. I, II- and III-Year Students) By Pandey O.P. & Bajpai D.N. & Giri S. (S. Chand & Company Ltd.)

Practical Chemistry-08/CHE/MJR/101P

(Major Course)

Exercise1.

Qualitative analysis of inorganic mixture containing 5-radicals (anions and cations), separation and identification of cations (group 0, I, II, III, IV, V and VI) and anions which may have special combination of acidic radicals (CO_3^{2-}, SO_3^{2-}; NO_3^-, NO_2^-; NO_3^-, Br^-; Cl^-, Br^-, I^-, S^{2-}, SO_3^{2-}, SO_4^{2-} **excluding** interfering radicals and insoluble)

Exercise2:

a) Determination of density of given liquid by RD bottle.

b) Sol Preparation: $Fe(OH)_3$, $Al(OH)_3$, As_2S_3

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SEMESTER-I

Title: Organic Chemistry-I

Course Code: (08/CHE/MJR/102T)

UNIT- I:

Mechanism of Organic Reactions: Electronic effects and their implications on characteristics of organic compounds. Bond cleavages. Types of reagents – electrophiles and nucleophiles. Reactive intermediates – carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Types of organic reactions. Methods of determination of reactions mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

UNIT- II

Stereochemistry of Organic Compounds: Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds. Resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometrical isomerism: Cis-trans isomers. E & Z system of nomenclature. Geometrical isomerism in oximes and alicyclic compounds. Determination of configuration of geometrical isomers.

Conformational isomerism: Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

conformational analysis of ethane, n-butane and their derivatives.

UNIT- III

Alkanes and Cycloalkanes: Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Sources, methods of formation and chemical conversions. Cycloalkanes – nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain-less rings. The case of cyclopropane ring: banana bonds. conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives.

UNIT- IV

Alkenes, Alkadienes and Alkynes: Olefins, Sources, methods of formation and chemical conversions. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, Chemical reactions – 1, 2-and 1, 4-additions, Diels-Alder reaction. Factors determining stability of unsaturated aliphatic hydrocarbons.

Polymerization and industrial polymers based on olefins and their derivatives.

Nomenclature, structure and bonding in alkynes. Sources, methods of formation. Chemical reactions of alkynes, acidic nature of terminal-alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, oxymercuration and polymerization.

UNIT- V

Arenes and Aromaticity: Structure of benzene: Kekule structure. Stability and carbon-carbon bond lengths in benzene, resonance structure, MO picture. Huckel's rule, aromatic ions. Nomenclature of benzene derivatives. Aryl group. Methods of formation and chemical reactions of alkylbenzenes,

Aromatic electrophilic substitution – general pattern of the mechanism, role of σ- and π- complexes. Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

Structure, preparation and properties of naphthalene.

Books suggested:

1. A Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl (S. Chand)
2. Organic Chemistry by Mukherji, Singh & Kapoor (New Age International Publishers)
3. Organic Chemistry by I L finar (Longmans Green and Co. Ltd.)
4. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
5. Stereochemistry by P.S. Kalsi, New Age Publication

Practical Chemistry-08/CHE/MJR/102P

(Major Course)

Exercise1:

Iodometric Titrations:

(i) To determine the strength of given unknown copper sulphate solution iodometrically using starch as indicator.

(ii) To determine the strength of given unknown potassium dichromate solution iodometrically using starch as indicator.

Exercise2:

Organic Models (Using Ball and Stick Model Box):

(I) R and S configuration of optical isomers

(II) D and L configuration of optical isomers

(III) E/Z configuration of geometrical isomers

(IV) Conformational isomerism of ethane and n-butane

SEMESTER-II

Title: Inorganic Chemistry-II

Course Code: (08/CHE/MJR/151T)

UNIT- I:

s-Block elements: Periodicity in properties of alkali and alkaline earth metals. Complexation tendency, Solvation tendency, stability and solubilities of carbonates, bicarbonates and sulphates of Magnesium and Calcium, Synthesis and applications of important hydrides: NaH, $NaBH_4$, LiH, $LiBH_4$, $LiAlH_4$ and CaH_2.

UNIT- II:

p-Block elements: Periodicity in properties of III A, IV A, V A, VI A and VII A group elements.

Silicates- Classification, Structure and applications. Introduction to silicone and their applications. Oxides of nitrogen, phosphorous and sulphur- structure and preparations.

Nitrogen fixation- Natural and Artificial fixation. Role of nitrogenase in biological nitrogen fixation.

UNIT- III:

Chemistry of first transition Series: General Characteristics and Periodicity in properties with emphasis on their electronic configuration and multiple oxidation states of 3d, 4d and 5d series elements.

Colored ion formation, magnetic, catalytic properties and complex formation tendency in 3d series elements

UNIT- IV:

Chemistry of second and third transition Series: General Characteristics and Periodicity in properties with emphasis on their electronic configuration and variable oxidation states of 4d and 5d series elements. Lanthanide contraction and its impact on the characteristic properties.

Metal complexes, colour of the salts, magnetic and catalytic properties.

UNIT- V:

f-Block elements: Chemistry of Lanthanides: Electronic structure, oxidation state, ionic radii, colors, spectral and magnetic properties. Lanthanide contraction and its consequences.

Chemistry of actinides: General characteristics, comparative treatment of actinides and lanthanides with respect to ionic radii, oxidation states, Magnetic behavior and spectral properties.

Books Suggested:

1. Shriver & Atkins' Inorganic Chemistry (Oxford University Press)

2. Selected Topics in Inorganic Chemistry by Wahid Malik, G D Tuli and R D Madan (S. Chand)

3. Principles of Inorganic Chemistry by B.R. Puri and L.R. Sharma and K C Kalia (Milestone Publisher and Distributor)

4. Concise inorganic Chemistry by J D Lee (Wiley India Pvt. Ltd.)

Practical Chemistry-08/CHE/MJR/151P

(Major Course)

Excersice1:

Acidimetry-Alkalimetry titration:

(a) Weak acid vs Strong base (Oxalic acid/NaOH)

(b) Strong acid vs Strong base (HCl and H_2SO_4 /NaOH)

Redox Titrations:

To determine the strength of given oxalic acid solution by titrating it against $KMnO_4$ solution

Exercise 2:

(a) Viscosity:

To determine the viscosity of the given organic liquid by Ostwald Viscometer

(b) Surface Tension:

To determine the surface tension of a given organic liquid by Stalagmometer.

SEMESTER-II

Title: Physical Chemistry-II

Course Code: (08/CHE/MJR/152T)

UNIT: I Gaseous State

Ideal gas behavior: kinetic theory of ideal gases. Real gases: Deviation from ideal behavior, the Vander Waals equation of state and its discussion.

Critical Phenomena: PV isotherms of real gases, continuity of states, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities (No derivation). Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect). Numerical.

UNIT: II Liquid state

Introduction, Classification of liquids, Intermolecular forces, Structural difference between solid, liquid and gas, Structure of liquid water. Properties of liquids; Surface tension and viscosity. Determination of surface tension by drop weight method and viscosity by Ostwald method. Liquid crystals, Classification of liquid crystals, nematic liquid crystals, smectic liquid crystals, cholesteric liquid crystals, Theory of liquid crystals (swarm theory. Applications of liquid crystals)

Unit III Colloidal State:

Definition of colloids, classification of colloids.

Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, Hardy-Schulze law, protective action, gold number.

Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier, Theory of Emulsion.

Liquids in solids (gels): classification, preparation and properties, imbibition and syneresis. General applications of colloids.

UNIT: IV Solutions

Colligative properties(Defination & examples), Types of liquid mixtures, ideal and non-ideal mixtures, vapour pressure of liquid mixtures, distillation of immiscible liquid mixtures.

Partially miscible liquids-phenol-water, triethylamine-water, nicotine-water-systems, consolute temperature-lower and upper, Effect of impurity on consolute temperature-Phenol-water system, immiscible liquids, Principle and Methodology of steam distillation. Numerical.

UNIT V Chemical Kinetics

Rate, order, molecularity and stoichiometry of a reaction, Derivation of Integrated rate law and characteristics of zero, first and second order reactions, Pseudo-first order reaction, Determination of the order of reaction-differential method, method of integration (hit and trial method), half-life method and isolation method.

Theories of Reaction Rate: Simple collision theory and its limitations, transition state theory (equilibrium hypothesis) and derivation of the rate constant, Thermodynamical formulation of rate constant, Comparison of collision theory and transition state theory, Numerical.

Books Suggested:

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
2. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
3. Dinesh Physical Chemistry by P N Kapil (S. Dinesh & Co.)
4. Atkins' Physical Chemistry (Oxford)

Practical Chemistry-08/CHE/MJR/152P

(Major Course)

Excersice1:

Exercise1.

Qualitative analysis of inorganic mixture containing 5-radicals (anions and cations), separation and identification of cations (group 0, I, II, III, IV, V and VI) and anions which may have special combination of acidic radicals (CO_3^{2-}, SO_3^{2-}; NO_3^-, NO_2^-; NO_3^-, Br^-; Cl^-, Br^-, I^-, S^{2-}, SO_3^{2-}, SO_4^{2-}) or interfering radicals or insoluble salt)

Excersice2.

Viscosity: To determine the % composition of a binary solution by Viscosity measurement.

Surface Tension: To determine the % composition of a binary solution by surface tension measurement

SEMESTER-III

Title: Organic Chemistry-II

Course Code: (08/CHE/MJR/201T)

UNIT- I

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Mechanism of elimination reactions of alkyl halides, regioselectivity in dehydrohalogenation, Saytzeff rule.
Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.
Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides towards nucleophilic-substitution reactions. Synthesis and uses of DDT and BHC.

UNIT- II

Aliphatic Hydroxy compounds: Classification and nomenclature of alcohols. Monohydric alcohols – nomenclature, structure and bonding, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters Formation by hydration of alkenes. Physical properties of alcohols, hydrogen bonding and its effect on boiling point and solubility. Acidic nature of alcohols and formation of alkoxides. Chemical reactions of alcohols – oxidation, dehydration, esterification, reaction with hydrogen halides and conversion into alkyl halides.
Dihydric alcohols – nomenclature and methods of formation. Chemical reactions of vicinal glycols, oxidative cleavage using $Pb(OAc)_4$ and HIO_4 and pinacol–pinacolone rearrangement.
Trihydric alcohols – nomenclature, methods of formation and chemical reactions of glycerol. Introduction to polyhydric alcohols and their applications.

UNIT- III

Aldehydes and Ketones: Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Use of acetals as protecting group. Oxidation and reduction of aldehydes and ketones, Baeyer-Villiger oxidation, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$.

UNIT- IV

Phenols: Nomenclature, structure and bonding in phenols. Preparation of phenols by different methods including hydrolysis of diazonium salts, Dow's process and from cumene. Physical properties and acidic character of phenols. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion and effect of substituents on acidity.
Chemical reactions of phenols – electrophilic aromatic substitution reactions such as nitration, halogenation and sulphonation, acylation and carboxylation reactions. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Hauben–Hoesch reaction, Lederer–Manasse reaction and Reimer–Tiemann reaction. Oxidation of phenols and introduction to polyhydric phenols such as catechol, resorcinol and hydroquinone.

UNIT- V

Carboxylic Acids: Nomenclature, structure and bonding in carboxylic acids. Physical properties and acidic nature of carboxylic acids. Effect of substituents on acid strength. Methods of preparation of carboxylic acids from alcohols, aldehydes, ketones, nitriles and Grignard reagents. Chemical reactions of carboxylic acids. Hell–Volhard–Zelinsky reaction. Reduction of carboxylic acids and their derivatives. Mechanism of decarboxylation, esterification and hydrolysis of esters (acidic and basic).
Introduction to dicarboxylic acids and their reactions.

Books Suggested:

1. A Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl (S. Chand)
2. Organic Chemistry by Mukherji, Singh & Kapoor (New Age International Publishers)
3. Organic Chemistry by I L finar (Longmans Green and Co. Ltd.)
4. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall

Practical Chemistry-08/CHE/MJR/201P

(Major Course)

Excersice1:

Qualitative Analysis: - Identification of organic compounds (one liquid and one solid) through the functional group analysis (containing only one functional group).

Excersice2: Preparations: (Inorganic)

i.Micro cosmic salt.,

ii.Ferrous Ammonium Sulphate

iii.Nickel ammonium sulphate,

iv.Sodium thiosulphate,

v.Ferrous Sulphate,

vi.Tetra ammine copper (II) sulphate,

SEMESTER-III

Title: Physical Chemistry-II

Course Code: (08/CHE/MJR/202T)

UNIT I Thermodynamics – I

Thermodynamic processes, Concept of heat and work, First Law of Thermodynamics: statement, definition of internal energy and enthalpy. Joule-Thomson Effect, Joule – Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Numerical.

UNIT II **Thermochemistry**

Enthalpy of reaction, exothermic and endothermic reactions, thermochemical equations, relationship between ΔE and ΔH, measurement of enthalpy of reaction, thermochemical equations, various types of enthalpy of changes, heat of combustion, heat of solution, heat of neutralization, energy changes during transitions or phase changes, heat of fusion, heat of vaporization, heat of sublimation, heat of transition, Hess's law of constant heat summation, applications of Hess's law, bond energy measurement of the heat of reaction.

UNIT III Thermodynamics – II

Second Law of Thermodynamics: need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem.

Entropy: Concept of Entropy, entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criterion of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases. Gibbs and Helmholtz function as thermodynamic quantities, Gibbs – Helmholtz equation. Third law of thermodynamics: Nernst heat theorem, Statement of third law and evaluation of absolute entropy from heat capacity data. Numerical

UNIT -IV Electrochemistry – I

Conductance, Specific conductance, equivalent conductance and molar conductance. . Activity, activity coefficient and ionic strength. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.

Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, Conductometric titrations and their types. Numerical.

UNIT- V Electrochemistry – II.

Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions. Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport (mathematical treatment), liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient.

Potentiometric titrations, Determination of pH using hydrogen, quinhydrone and glass electrodes. Numerical.

Books Suggested:

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
2. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
3. Dinesh Physical Chemistry by P N Kapil (S. Dinesh & Co.)
4. Atkins' Physical Chemistry (Oxford)

Practical Chemistry-08/CHE/MJR/202P

(Major Course)

Excersice1:

Qualitative Analysis: - Separation and Identification of organic compounds in given binary organic mixture of two solids.

Excersice2

To determine the strength of NaOH and Na_2CO_3 present in a solution and find the percentage composition (Volumetrically).

SEMESTER-IV

Title: Inorganic Chemistry-III

Course Code:08/CHE/MJR/251T

UNIT- I:

Coordination compounds: Werner's coordination theory and experimental verification, Effective Atomic Number concept, chelates, nomenclature of coordination compounds, stereoisomerism in complexes of coordination number 4 and 6. Complexometric titrations and theory of Metallo chrome indicators.

UNIT- II:

Metal-Ligand bonding in transition metal complexes: Valence bond theory of complexes and its limitation, Crystal field theory, Crystal field splitting of energy levels in octahedral, tetrahedral and square planer complexes, crystal-field stabilization energy of octahedral complexes (Calculation Only).

UNIT- III:

Stability of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability. Kinetic stability, labile and inert complexes, colour of transition metal complexes, effective atomic number (EAN), pi accepter ligands, experimental determination of stability constant and composition of complex (Job's Method and Bjerrum's Method).

UNIT- IV:

Hard and soft Acid Base Concept (HSAB): Classification of acid and base as hard and soft. Pearson's HSAB concept and its application.

Magnetic properties of transition metal complexes: Types of magnetic behaviour, magnetic properties of metal complexes, spin only formula, methods of determining magnetic moment and magnetic susceptibility.

UNIT- V:

Quantitative analysis: Types of quantitative analysis: Gravimetric and volumetric analysis.

Volumetric Analysis: Terms, Basic principle, standard solutions, types of standard solutions (Primary and Secondary).

Gravimetric Analysis: Steps involved. Precipitation, Digestion, Filtration, Washing, Drying, Ignition, Weighing. Advantages of gravimetric analysis, Cautions in Gravimetry, Co-precipitation and Post precipitation

Books suggested:

1. Shriver & Atkins' Inorganic Chemistry (Oxford University Press)

2. Selected Topics in Inorganic Chemistry by Wahid Malik, G D Tuli and R D Madan (S. Chand)

3. Principles of Inorganic Chemistry by B.R. Puri and L.R. Sharma and K C Kalia (Milestone Publisher and Distributor)

4. Concise inorganic Chemistry by J D Lee (Wiley India Pvt. Ltd.)

5. Practical Chemistry (For B.Sc. I, II- and III-Year Students) By Pandey O.P. & Bajpai D.N. & Giri S. (S. Chand & Company Ltd.)

Practical Chemistry-08/CHE/MJR/251P

(Major Course)

Excersice1:

Chemical Kinetics:

- **(i)** To study the hydrolysis of an ester catalyzed by an acid and determine the rate constant and order of reaction.
- **(ii)** To study saponification of ester and determine the rate constant and order of reaction.
- **(iii)** To study the reaction b/w acetone and iodine with respect to iodine and determine the rate and order of reaction.

Excersice2:

Synthesis of organic compounds: -

- (i) Preparation of iodoform from ethanol and acetone.
- (ii) Diazotization/Coupling of primary aromatic amines (aniline).
- (iii) Preparation of methyl orange.
- (iv)

SEMESTER-IV

Title: Advanced Chemistry-I

Course Code: 08/CHE/MJR/252T

UNIT - I

Organic Compounds of Nitrogen: Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.
Alkyl and Aryl amines: Reactivity, structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basic nature of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds. nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

UNIT- II

Heterocyclic Compounds: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basic nature of pyridine, piperidine and pyrrole.
Introduction to condensed five and six – membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

UNIT- III

Organometallic Compounds: Organometallic compounds: The Grignard reagents—formation, structure and chemical reactions. Organo zinc and Organolithium compounds: Formation and chemical reactions.

Organosulphur Compounds: Study of nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

UNIT- IV

Electromagnetic Spectrum: Absorption Spectra, Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. UV applications including identification of groups.

UNIT-V.

Spectroscopy: Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (1H PMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

Books suggested:

1. A Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl (S. Chand)
2. Organic Chemistry by Mukherji, Singh & Kapoor (New Age International Publishers)
3. Organic Chemistry by I L finar (Longmans Green and Co. Ltd.)
4. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
5. Elementary Organic Spectroscopy by Y.R. Sharma, S. Chand Pub.

Practical Chemistry-08/CHE/MJR/252P

(Major Course)

Excersice1:

a) Distribution law: To determine the partition coefficient of benzoic acid between water and benzene at R.T.

b) Adsorption: To study the adsorption of acetic acid by activated charcoal and verify the Freundlich adsorption isotherm

Excersice2:

Complexometric Titration:

To determine the Ca^{+2}/Mg^{+2} in given solution by titration with EDTA.

SEMESTER-V

Title: Inorganic Chemistry-IV

Course Code:08/CHE/MJR/301T

UNIT- I:

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds, bonding, preparation, properties and application of organometallic compounds of Li, Al, Hg and Sn (alkyls and aryl).

UNIT- II:

Bioinorganic Chemistry: Essential and trace elements in biological processes,

Biological role of alkali (Na, K, Li) and alkaline earth (Mg, Ca) metals. Role of iron in

biological process. Biological Nitrogen fixation.

Non-aqueous solvents.

UNIT- III:

Concepts of acids and bases: Arrhenius, BrÖnsted-Lowry, Lewis and Usanovich concept. Acid base titrations, Theory of indicators, Redox titrations.

Non aqueous solvents: Physical properties of solvent, types of solvents and their general characteristics. Reactions in non- aqueous solvents with reference to liquid NH_3 and liquid SO_2.

UNIT-IV:

Metallurgy of Typical Metals: Metallurgy of Copper and platinum from their main ores. extraction of Zinc from zinc blende, extraction of uranium from pitch blende. Uses of Uranium

UNIT-V:

Cement: Composition and types of Cement, Manufacture of Portland

cement.

Lime: Industrial preparation, Properties and Uses.

Glass: Types and properties of glasses, colouring agents, Industrial manufacturing of

glass.

Books Suggested:

1. Shriver & Atkins' Inorganic Chemistry (Oxford University Press)

2. Selected Topics in Inorganic Chemistry by Wahid Malik, G D Tuli and R D Madan (S. Chand)

3. Principles of Inorganic Chemistry by B.R. Puri and L.R. Sharma and K C Kalia (Milestone Publisher and Distributor)

4. Concise inorganic Chemistry by J D Lee (Wiley India Pvt. Ltd.)

Engineering Chemistry

5.Dr. T. L. Rajawat, Dr. Vivek Pandey, Dr. Sudha Calla, Dr. Sama Jain (Neelkanth Publishers)

Practical Chemistry-V-08/CHE/MJR/301P

(Major Course)

Excersice1:

Gravimetric analysis (by using Silica / Sintered Crucible)

(i) To estimate Barium as barium sulphate in given barium chloride solution.

(ii) To estimate zinc as zinc oxide from zinc sulphate solution.

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Excersice2:

To estimate the hardness of water (Temporary and Permanent) in the given water sample by EDTA method.

SEMESTER-V
Title: Physical Chemistry-III
Course Code:08/CHE/MJR/302T

UNIT- I

Elementary Quantum Mechanics: Black-body radiation, Planck's radiation law, photoelectric effect. Compton effect, De Broglie hypothesis, the Heisenberg's uncertainty principle, Schrodinger wave equation and its importance, physical interpretation of wave function. Postulates of quantum mechanics, Schrodinger equation for particle in one dimensional box.

UNIT- II

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non- radiative processes (Internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples). Numerical.

UNIT- III

Solid State: Crystal state, classification of crystals, space lattice, unit cell.

Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method). Numerical.

UNIT- IV

Phase Equilibrium: Statement and meaning of the terms – phase, component and degree of freedom, Gibbs phase rule, phase equilibria of one component system; water and sulphur systems.

Phase equilibria of two-component system: simple eutectic systems, – Pb-Ag system, de siliverisation of lead.

Nernst distribution law, deviations from Nernst Law, applications to study of complex ion and solvent extraction.

UNIT- V

Adsorption: Introduction, Difference between adsorption, absorption and sorption, Chemisorption, adsorbent and adsorbate, reversible and irreversible adsorption, characteristics of adsorption, adsorption of gases by solids, factors affection adsorption, types of adsorption, types of adsorption isotherms, Freundlich and Langmuir adsorption isotherms, applications of adsorption, ion-exchange adsorption, applications of ion-exchange adsorption.

Books Suggested:

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
2. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
3. Dinesh Physical Chemistry by P N Kapil (S. Dinesh & Co.)
4. Atkins' Physical Chemistry (Oxford)

Practical Chemistry-08/CHE/MJR/302P

(Major Course)

Excersice1:

To determine relative efficiency of given two different detergents using surface tension measurement.

Excersice2

Inorganic Preparations:

i. Chrome alum
ii. Sodium thiosulphate
iii. Potassium trioxalato chromate
iv. Potash alum

SEMESTER-VI
Title: Organic Chemistry-III
Course Code: (08/CHE/MJR/351T)

UNIT-I:

Amino Acids: Classification, structure and stereochemistry of amino acids; Acid-base behavior, isoelectric point, electrophoresis and separation of amino acids by chromatography. Preparation and reactions of α-amino acids. Distinctive properties of α-, β-, and γ-amono acids. analysis of amino acid. Glycine- preparation, physical & chemical properties.

UNIT-II:

Introduction to Carbohydrates: Classification and nomenclature. Monosaccharides, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose, mechanism of osazone formation, Cyclic structure of D (+)-glucose. Mechanism of mutarotation.
Occurrence of sucrose, manufacture of sucrose, physical and chemical properties of sucrose, configurational structure of sucrose, uses and analytical test of sucrose, constitution of sucrose. Structure of starch and cellulose.

UNIT-III:

Proteins: Introduction, of proteins. Classification of proteins. selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Peptide structure determination, end group analysis, Structures of peptides and proteins. Protein denaturation/renaturation. Analytical tests and uses of proteins.

UNIT-IV:

Fats, Oils, Detergents: Introduction to oil and fats. Mineral oils, essential oils. Extraction, physical and chemical properties of oil and fats. Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Analysis of oil & fats- Saponification value, iodine value, acid value, R/M value.
Lipids- Introduction to lipids, general physical and chemical properties, classification: simple lipids, compound lipids, lipoproteins, derived lipids, classification based on fatty acids,
Soaps & soap less detergents. Soaps- manufacture of soap, toilet soap & laundry soap, special varieties of soaps, cleansing action of soap. Synthetic detergents, alkyl and aryl sulphonate, micelles, various types of micelles.

UNIT-V: INDUSTRIAL POLYMERS:

Synthetic polymers: classification and general properties of polymers. Addition or chain-growth polymerization including free radical vinyl polymerization, ionic vinyl polymerization and Ziegler–Natta polymerization, vinyl polymers such as polyethylene, polypropylene and PVC. Condensation or step-growth polymerization. Preparation and properties of polyesters, polyamides, phenol–formaldehyde resins, urea–formaldehyde resins, epoxy resins and polyurethanes. Introduction to natural polymers, biodegradable polymers and applications of polymers in industry and daily life. Natural rubbers, synthetic rubbers, Buna rubbers. Silicone rubber- introduction, history, curing, properties. Comparison of silicon rubbers with organic rubber. Silicone rubber vs thermoplastics vs thermoplastic-elastomers.

Books Suggested:

1. A Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl (S. Chand)

2.Organic Chemistry by Mukherji, Singh & Kapoor (New Age International Publishers)

3.Organic Chemistry by I L finar (Longmans Green and Co. Ltd.)

4.Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall

5. Polymer Science by V.R. Gowariker, New Age Pub.

Practical Chemistry
08/CHE/MJR/351P
(Major Course)

Excersice1:

To study the reaction b/w acetone and iodine with respect to acetone and determine rate and order of reaction.

To determine relative strength of two acids by study of kinetics of ester hydrolysis.

Excersice2:

Acidimetry-Alkalimetry titration:

(a) To determine strength of weak acid by titrating with Strong base (Oxalic acid/NaOH)

(b) To determine strength of strong acid by titrating with Strong base (HCl and H_2SO_4 /NaOH)

SEMESTER-VI

Title: Advanced Spectroscopy

Course Code:08/CHE/MJR/352T

UNIT I: Spectroscopy:

Introduction: electromagnetic radiation, regions of the spectrum, Basic features of different Spectrometers, Born-Oppenheimer approximation, degrees of freedom. Types of Molecular Spectrum.

UNIT II: Rotational Spectrum: Introduction, Diatomic molecules, Rigid rotator, Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotator, isotope effect. Numericals.

UNIT III: Vibration Spectroscopy:

Vibrational Spectrum: Introduction, Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules for the vibrational transitions in simple harmonic oscillator,, pure vibrational spectrum, Vibrational energy levels of an Anharmonic oscillator, Vibrational rotational spectra, intensities of spectral lines, determination of force constant and qualitative relation of force constant and bond energies, isotopic effect idea of vibrational frequencies of different functional groups, Conditions for infrared spectrum, Modes of vibration. Numerical.

UNIT IV: Raman Spectroscopy: Introduction, Stoke and Antistoke lines, concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Advantages of Raman Spectroscopy over Infrared Spectroscopy.

UNIT V: Electronic Spectrum: Origin of electronic spectrum, Theory of electronic band spectra, vibrational course structure of electronic spectra, Rotational fine structure of electronic spectra, Franck-Condon principle. Electronic transitions in molecular orbitals, selection rules, σ, π and n molecular orbitals, their energy levels and the respective transitions, Applications of electronic spectrum, electronic spectra of poly atomic molecules.

Books Suggested:

1. Fundamentals of Molecular Spectroscopy by Banwell
2. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
3. Physical Chemistry by Bahl & Tuli (S. Chand & Co.)
4. Dinesh Physical Chemistry by P N Kapil (S. Dinesh & Co.)
5. Atkins' Physical Chemistry (Oxford)

Practical Chemistry-08/CHE/MJR/352P

(Major Course)

Excersice1:

To determine strength of given glucose solution volumetrically using Benedict solution.

To determine strength of given glucose solution volumetrically using Fehling solution.

Excersice2:

To determine pH of given solutions

VII SEMESTER

Title: INORGANIC CHEMISTRY

Course Code: 08/CHE/MJR/401T

Unit I

Stereochemistry and bonding in compounds : Mulliken symbols for s,p and d orbitals in C_{2v}, D_{3h}, D_{4h}, T_d, & O_h point groups, , d π -p π bonds and synergic bonding, Bent's rule and valence shell election pair repulsion(VSEPR) theory in structure elucidation with applications, Wave functions and Energetics of different types of hybridization. Simple reactions of covalently bonded molecules related to atomic inversion, Berry pseudo rotation, Nucleophilic displacement and free radical reactions. Limitations of crystal field theory, Jahn Tellor theorem and distortion of molecules

Unit II

Molecular orbital theory (MOT) : Shapes of molecular orbitals, Walsh diagram of tri atomic molecules with special reference to H_2O, molecular orbital theory of hetero atomic molecules viz . BeH_2, CO_2, NO_2, BF_3 . Coulson diagram of CO. Molecular orbital theory (MOT) of octahedral, tetrahedral and square planer complexes, π - bonding and molecular orbital theory, Comparison with VBT and CFT.

Unit III

Metal Ligand Equilibrium in solution : Thermodynamic and kinetic stability of compexes, stepwise and overall formation constant, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, Chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and Spectrophotometry viz Bjerrum, Job, Dey and Mukherjee, Asmus methods.

Unit IV

Correlation diagrams of Transition Metal Complexes:Types of transitions, selection rules and relaxation for electronic transition, coupling and micro states, Spectroscopic ground States and Term symbols, correlation diagrams, Orgel and Tanabe sugano diagrams. Racah Paramerters and Calculations of Dq. B and β parameters for d^1 to d^{10} states in Transitions metal complexes

Unit V

Electronic spectra and Magnetic properties of transitions metal Complexes

Charge transfer spectra,Spectroscopic methods of assignment of absolute configuration in optically active metal chelates and their stereo chemical information using ORD and CD based Cotton effect, Anomalous magnetic moment, spin crossover and it's affecting factors, magnetic exchange coupling for ferromagnetism and anti ferromagnetism, Curie temperature (T_C) and Neel Temperature (T_N)

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. greenwood and A.Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. lever, Elsevier.
5. Magnetochemistry, R.L.Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and LA McCleverty, Pergamon.
7. Advanced Inorganic Chemistry, S.K. Agarwal, Keemti Lal, Pragati Prakashan.

PRACTICAL CHEMISTRY

08/CHE/MJR/401P

Inorganic Lab

Exercise 1:

Qualitative Analysis

Eight component mixture including two less common metal ions (TI, Mo, W, Ti, Zr, Th, V, U in cationic/anionic forms) and insoluble – oxides, sulphates and halides.

Exercise 2:

Chromatography

Separation of cations and anions by

a) Paper Chromatography: Separation of chloride, bromide and iodide
b) Column Chromatography – separation of Cu, Ni, Co by Ion exchange.

Exercise 3:

Preparations

Preparation of selected inorganic compounds and their studies by I.R., electronic Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

(1) $VO(acac)_2$

(2) $Cis\text{-}K[Cr(C_2O_4)_2(H_2O)_2]$

(3) $Na[NH_3)_2(SCN)_4]$

(4) $Mn(acac)_3$

(5) $K_3[Fe(C_2O_4)_3]$

(6) Prussian Blue, Turnubull's Blue

VII SEMESTER

Title: ORGANIC CHEMISTRY

Course Code:08/CHE/MJR/402T

UNIT I

Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, reasonance hyperconjugation, bonding in fullerenes, tautromerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternate and non-alternate hydrocarbons, Huckel's rule, energy level of π-molecular orbitals, annulenes aromaticity, homo-aromaticity, Double aromaticity, High Temperature Aromaticity, excited state aromaticity, PMO (approach).

Bonds weaker than covalent- addition compounds, crown ether complexes, cryptands inclusion compounds, cyclodextrins, catenanes and rotaxanes.

UNIT II

Stereochemistry I

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity conformation of sugars, steric strain due to unavoidable crowding. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

UNIT III

Stereochemistry II

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

UNIT IV

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control. Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanism isotope effects. Hard and Soft acids and bases.

Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes.

Effect of structure on reactivity – resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship. substituent and reaction constants. Taft equation.

UNIT V

Pericyclic Reactions

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

Sigmatropic rearrangements – suprafacial and antrafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions, S.M.Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry S.M.Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry Organic Compounds, D.N.asipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S.Kalsi, New Age Internationa.
12. Pericyclic Reactions by Jagdama Singh.

PRACTICAL CHEMISTRY

08/CHE/MJR/402P

ORGANIC LAB

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid), chemical tests, Interpretation of IR Spectra of simple compounds.

Two Step Organic Synthesis

Acetylation: Acetylation of glucose and hydroquinone.

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.

Aromatic electrophilic substitutions: Synthesis of p-nitroaniline (1^{st} step synthesis of p-nitroacetanilide from the acetanilide: 2^{nd} step, synthesis of p-nitroanline from p-nitroacetanilide), and Synthesis of p-bromoaniline (1^{st} step synthesis of p-bromoacetanilide from the acetanilide; 2^{nd} step synthesis of p-bromoaniline from p-bromoacetanilide).

VII Semester

Title: PHYSICAL CHEMISTRY

Course Code:08/CHE/MJR/403T

UNIT I

Chemical Kinetics-I

Chemical Dynamics: Ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde). photochemical (hydrogen-bromine and hydrogen-chlorine reactions) .

UNIT II

Chemical Kinetics-II

Homogeneous and heterogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, and flash photolysis method.

Dynamics of complex Reactions, Collision and Transition state, Theories of Rate Constant, dynamics of unimolecular reaction, Lindemann and Hinshelwood theories of unimolecular reactions.

UNIT III

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids Electro-kinetic phenomenon and quantitative treatment of Zeta potential.

Micelles: Surface active agents, classification of surface-active agents, micellization, types of ionic micelles present in colloidal electrolytes, critical micellar concentration (CMC), factors affecting the CMC of surfactants,

UNIT IV

Macromolecules

Polymer – definition, types of polymers,, kinetics of polymerization,

Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, calculation of average dimensions of various chain structures.

UNIT V

Electrochemistry

Electrochemistry of solutions. Debye-Huckel – Onsagar treatment and its extension, Debye-Huckel-Jerrum mode, ion - solvent interactions, Born model.

Thermodynamics of electrified interface; Derivation of electrocapillary Lippmann equation (surface excess), Structure of electrified interfaces. Helmholtz, Guoy-Chapman and Stern models.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Megraw-Hill
3. Kinetics and Mechanism of Chemical Transformation, J.Rajaraman and J.Kuriacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N.Reddy, Plenum.
6. Introduction to Polymer Science, V.R.Gowarkar, N.V.Vishwananathan and J.Sridhar, Wiley Eastern.

VII Semester

PRACTICAL CHEMISTRY

08/CHE/MJR/403P

Physical Lab

Surface Tension

To determine the parachor of carbon and hydrogen atoms by drop weight method.

Chemical Kinetics

(i) Determination of the effect of

(a) Change of temperature

(b) Change of concentration of reactant and catalyst.

(c) Ionic strength of the media on the velocity constant of acid hydrolysis of an ester

(ii) To study the effect of acid strength on the reaction of acetone and iodine.

Adsorption

(i) To study surface tension-concentration relationship for solutions (Gibbs equation) and hence determine the limiting cross-sectional area of molecule.

(ii) To study the adsorption of acetic acid/oxalic acid by activated charcoal and verification of Freundlich and Langmuir's isotherms.

Book Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J.Bassett, R.C. Denney, GH.H. Jeffery and J. mENDHAM, elbs.
2. Synthesis and Characterization of Inorganic Compounds, W.L.Jolly, Prentice Hall.
3. Practical Physical Chemistry, A.M.James and F.E. Prichard, Longman.
4. Findley's Practical Physical Chemistry, B.P.Levitt, Longman.
5. Experimental Physical Chemistry, R.C.Das and B.Behera, Tata McGraw Hill.
6. Advanced Practical Physical Chemistry, J.B.Yadav, Goel Publishing House.
7. Advanced Experimental Chemistry, Vol. I Physical, J.N.Gurtu and R.Kapoor, S.Chand & Co.

VIII Semester

Title: ADVANCED ORGANIC CHEMISTRY

Course Code: 08/CHE/MJR/451T

UNIT I

Aliphatic Nucleophilic Substitution

The SN_2, SN_1, mixed SN_1 and SN_2 and SET mechanisms.

The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.

The S_Ni mechanism.

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution

Bimolecular mechanisms- S_E2 and SE^i. The S_E1 mechanism, electrophilic substitution accompanied by double shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT II

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution

The S_NAr S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Ritcher, Sommelet-Hauser, and Smiles rearrangements.

UNIT III

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.

Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

UNIT IV

Addition to Carbon-Carbon Multiple Bouds

Mechanistic and sterochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidatio.

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, Organozinc and Organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.

Meehanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

UNIT V

Elimination Reactions

The E2, E1 and E1cB mechanisms and their spectrum, Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium.

Mechanism and orientation in pyrolytic elimination.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M.Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

VIII Semester

PRACTICAL CHEMISTRY

08/CHE/MJR/451P

Exercise 1:

Quantitative Analysis

Separation and estimation of metal ions in a binary mixture Cu-Ni, Ni-Zn, Cu-Ag etc. involving volumetric and gravimetric methods.

Exercise 2:

Quantitative Analysis

Determination of the percentage weight and number of hydroxyl group in an organic compound by acetylation method.

Estimation of amines/phenols using bromate bromide solution/or acetylation method.

Determination of Iodine and Saponification values of an oil sample.

Determination of DO, COD and BOD of water sample.

Exercise 3:

Inorganic Preparations:

1. $[Co(NH_3)_6][Co(NO_2)_6]$
2. Cis-$[Co(trine)(NO_2)_2]Cl.H_2O$
3. $Hg[Co(SCN)_4]$
4. $\{Co(Py)_2Cl_2]$
5. $[Ni(NH_3)_6]Cl_2$
6. $Ni\ (dmg)_2$

VIII Semester

Title: ELECTRO ANALYTICAL CHEMISTRY

Course Code: 08/CHE/MJR/452T

Unit I Introduction to Instrumentation:

Basic components of analytical instruments, Analog & digital signals, Basic digital circuit components, DAC & ADC. Operational Amplifiers (for current, potential, resistance/conductance), Automation in analysis: Automatic & Automated instruments, Process control analyzer, Continuous analyzer & Discrete analyzer, Flow injection analysis, Microprocessor controlled smart instruments

Unit II Thermal Analysis: Introduction to thermal Analysis; Thermogravimetric Analysis(TGA) : Basic Principle , Instrumentation and applications. Differential thermal Analysis (DTA) : Principle , Instrumentation and Applications of DTA . Introduction to Differential scanning calorimetry (DSC).

Unit III Electrochemistry :

Electrochemical Cell and its types, Ion Selective Electrodes: Types (Glass membrane, Precipitate, Solid State, Liquid-Liquid, Enzyme), Mechanism of Glass membrane ISE , Advantages and limitations of ISEs. Introduction to Sensors and their types,. Electrochemical corrosion its types, theories and prevention methods.

Unit IV Electroanalytical Methods :

DC Polarography: theoretical principle, Significance of Ilkovic equation, Half wave potential and their significance. Different wave forms & Current-Voltage Curves. Cyclic Voltammetry: Theoretical Principle, Randle-Sevick Equation, Determination of Heterogenous Rate Constant (K_s), Criteria of reversibility by CV. Application of Voltammetry in Inorganic & Organic Analysis, Chronoamperometry, chronopotenmetry Electrochemical Impedance spectroscopy(EIS), Scanning Electrochemical Microscopy (SECM)

Unit V: Photoelectrochemical Methods:

Photoelectrochemical cell and its types ,Photogalvanic cell, Photovoltaic cell, working Mechanism ,Dye sensitizer solar cell, Principle, Methodology and applications,: Solar energy conversion and storage, photocurrent and photovoltage measurement , conversion efficiency, fuel cell and batteries , photoelectrolysis

Books Suggested:

1. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, CBS Publ. Delhi.
2. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, Publ. W B Saunders
3. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
4. Solar Energy Conversion: A Photoelectrochemical Approach, Yuri V. Pleskov **Publisher:** Springer (Berlin, Heidelberg)

VIII Semester

PRACTICAL CHEMISTRY

ANALYTICAL Lab

Conductometry:

(1) Estimation of Oxalic acid by Conductometric Titration in following solutions
   (a) A solution of pure oxalic acid
   (b) A solution of oxalic acid and HCl

(2) To titrate a given mixture of sulphuric acid, acetic acid and Copper Sulphate conductometrically.

Environmental Analysis:

(1) Determination of carbon dioxide, carbon monoxide, oxygen and nitrogen in air sample using Orsat apparatus.

(2) Determination of NO_2^- by spectrophotometry in environmental samples.

Electrophoresis:

(1) To study the separation of amino acids in a mixture by electrophoresis.

(2) To Determine isoelectric point of glutamic acid by paper electrophoresis.

TLC :

(1) Separation of dyes by TLC

(2) Separation of pharmaceutical Samples by TLC

(3) Study of reaction monitoring by TLC

Books Suggested:

1. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
2. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, John Wiley. Experiments and Techniques in Organic Chemistry, D. Pasto, C.Johnson and M.Miller, Prentice Hall
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.