

INSTITUTE OF SCIENCE, NAGPUR.

(An Autonomous Institute of Government of Maharashtra)

DEPARTMENT OF CHEMISTRY



Syllabus

Bachelor of Science (B.Sc.) Semester Pattern

Chemistry

(CHE/UG/2021/01)

(To be Implemented from 2021-2022)

SUBJECT: CHEMISTRY

B.Sc. –I SEMESTER - I

BCFS11: PAPER- I (INORGANIC CHEMISTRY)

Unit-I

(7.5 Hrs)

(A) **Atomic Structure** :Idea of de-Broglie matter Waves, Heisenberg's uncertainty principle.Schrodinger wave equation, significance of Ψ and Ψ^2 , Quantum numbers, shapes of s, p, and d orbitals, Aufbau principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity.Electronic Configuration of elements and ions ($Z = 1$ to 30)

(B) **Periodic Properties**: Atomic and ionic radii, ionization energy, electron affinity and electronegativity- Definition, trends in periodic table. Factors affecting ionization potential.Pauling's and Mulliken's scale of electronegativity.Effective nuclear charge and Slater's rule with some numericals.

Unit-II

(7.5 Hrs)

(A) **Ionic bond** :Introduction to Ionic bonding with respect to formation (Kossel Theory), Lattice energy and Born- Habercycle with numericals. Solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajans rule.

(B)**Covalent Bond**: Valence Bond Theory, Formation of Hydrogen molecule with Potential energy diagram Limitations of VBT, directional characteristics of covalent bond, overlap criterion and bond strength. Bond energy, bond length, Bond order and Bond angle. Various types of hybridization involving s, p, d orbitals and shape of inorganic molecules.

Unit – III

(7.5 Hrs)

(A) **s- block elements**- Electronic configuration, Comparative study with respect to atomic and ionic radii, Ionization potential, reducing properties. Application of s-block elements(Na, K, Ca) in biosystem.Diagonal Relationships (Li-Mg).Hydrogen bonding .Classification and effect of Hydrogen bonding on viscosity, solubility, Melting point and Boiling point.

(B) **Chemistry of Noble Gases**: Chemical properties of the noble gases, Preparation, chemical properties, structures, bonding and applications of Xenon fluorides (XeF_2 , XeF_4 , XeF_6).Structure and bonding in XeOF_2 and XeOF_4

Unit- IV

(7.5 Hrs)

(A) **p-block elements** – Introduction to p-block elements with respect to following compounds:

Hydrides: Comparative study with respect to structure of NH_3 , PH_3 , AsH_3 and SbH_3 .

Oxides: Structure of P_2O_3 , P_2O_5 Oxyacids of Phosphorous: Structure of H_3PO_3 and H_3PO_4

Peroxyacids of sulphur: Preparation and structure of Caro's and Marshall's acids.

Hydrides of boron: Structure and bonding of diborane, structure of borazine.

(B) **Food Adulteration and Detection**: Definition, Conditions of adulteration, Types of adulteration (intentional, unintentional, natural) . Chemical contamination, Simple tests for the detection of food adulteration in tea leaves and coffee, spices(turmeric and chilli powder)and, milk.

SUBJECT: CHEMISTRY

B.Sc. –I SEMESTER - I

BCFS12: PAPER- II (PHYSICAL CHEMISTRY)

Unit - I: Thermodynamics

7.5 Hrs

(A) Definitions of some common thermodynamic terms: system, surrounding, types of systems: open, closed, isolated, homogeneous and heterogeneous systems, extensive and intensive properties, thermodynamic processes:

isothermal, adiabatic, isochoric, isobaric, cyclic, reversible and irreversible processes, concept of heat and work, Zeroth law of thermodynamics, First law of thermodynamics, internal energy, enthalpy, heat capacity, relationship

between C_p and C_v . Joule-Thomson effect, Joule-Thomson experiment, Joule-Thomson coefficient and inversion temperature.

(B) Thermochemistry: Standard states, enthalpy of formation, enthalpies of compounds, enthalpy of combustion, enthalpy of solution, enthalpy of dilution, enthalpy of neutralisation, enthalpy of ionisation. Hess's law of constant heat summation and its applications, heat of reaction, relationship between heat of reaction at constant volume and at constant pressure, average bond energy, bond dissociation energy and its calculations from thermochemical data. Numerical problems.

Unit-II: Gaseous State

7.5 Hrs

(A) Postulates of kinetic theory of gases, derivation of kinetic gas equation, deductions of various gas laws from kinetic gas equation: Boyle's law, Charles's law, Avogadro's law, Graham's law, Dalton's law, Ideal gas equation. Qualitative discussion of Maxwell-Boltzmann distribution of molecular velocities, effect of temperature on molecular velocities, different types of molecular velocities with their expressions and interrelationships: average, root mean square and most probable velocities, collision diameter, collision number and mean free path.

(B) Ideal and real gases, deviation of real gases from ideal behaviour, explanation of the terms: compressibility factor and Boyle temperature, causes of deviation from ideal behaviour, Vander-Waal's equation of state, explanation of behaviour of real gases by Vander-Waal's equation, Andrew's experiment on critical phenomenon: isotherms of CO_2 , continuity of state, isotherms of VanderWaal's equation, relationship between critical constants and Vander Waal's constants, reduced equation of state and law of corresponding states. Numerical problems.

Unit-III: Liquid State

7.5 Hrs

(A) Intermolecular forces: dipole-dipole attraction, ion-dipole attraction, dipole-induced dipole attraction and induced dipole-induced dipole attractions, models of liquid state, structural differences between solids, liquids and gases, liquid crystals, types of liquid crystals: nematic, smectic and cholesteric liquid crystals, difference between liquid crystal, solid and liquid, thermography, liquid crystal display and seven segment cells.

(B) Properties of liquid: surface tension, measurement of surface tension by capillary rise method and drop number method, parachor and its applications, viscosity, coefficient of viscosity, effect of temperature on viscosity. Relative viscosity, specific viscosity, reduced viscosity and intrinsic viscosity, determination of viscosity by Ostwald's viscometer, refractive index, determination of refractive index by Abbe's refractometer, specific refraction, molar refraction. Numerical problems.

Unit-IV: Surface Chemistry, Catalysis and Colloidal State

7.5 Hrs

(A) Adsorption: Physical and chemical adsorption, difference between physisorption and chemisorption, Freundlich adsorption isotherm, Langmuir adsorption isotherm, applications of adsorption. Catalysis, characteristics of catalyst, homogeneous and heterogeneous catalysis, promoters and inhibitors, autocatalysis, enzyme catalysis, applications of catalysts.

(B) Colloidal states: Introduction, types of colloidal systems, classification of colloids, true solutions, colloidal solutions and suspensions. General properties of colloidal systems, properties of hydrophobic colloidal systems (a) electrical properties: charge on colloidal particles, coagulation of colloidal sols: Hardy and Schulzer rule, Gold number (b) electrokinetic properties: electrophoresis and electro-osmosis. Surfactants, types of emulsions, emulsifiers, gels, preparation of gels, importance and application of colloids. Numerical problems.

BCFS13: LABORATORY COURSE

Practical- I (Inorganic Chemistry):

Semi micro Qualitative Analysis Qualitative analysis of inorganic salt mixture containing two acidic radicals of different group and two basic radicals of same groups. (At least six mixtures to be analysed)

1. To detect presence of iron, coal tar and catechu (as adulterants) in Tea powder.
2. To detect presence of brick powder and Rhodamine B (as adulterants) in chili powder.
3. To detect yellow lead salt and chalk powder (as adulterants) in Turmeric powder
4. To detect urea and sugar (as adulterants) in milk.

Practical-II (Physical Chemistry)

1. Determination of heat of solution of potassium nitrate calorimetrically.
2. Determination of heat of ionisation of acetic acid calorimetrically.
3. Determination of integral heat of solution of salt at two different concentrations and hence determine integral heat of dilution.
4. Determination of viscosity coefficient of unknown liquid by Ostwald's viscometer.
5. Determination of surface tension of given liquid by drop number method (Stalagmometer method)
6. To compare cleansing power of two samples of detergent.
7. To determine refractometrically specific and molar refractions of given liquids.
8. To study the adsorption of oxalic acid on activated charcoal and verify Freundlich adsorption isotherm

Reference Books (Theory):

1. Barrow G. M; Physical Chemistry, Tata Mc Grow Hills(2007).
2. Castellan G. W; Physical Chemistry, Narosa (2004).
3. Puri B. R; Sharma L. R; Pathania M. S; Principles of Physical Chemistry, Vishal Publishing Company (2018).
4. Gurdeep Raj; Advanced Physical Chemistry, Goel Publishing House (2009).
5. Bajpai D.N; Advanced Physical Chemistry, S. Chand Publishing (2001).
6. Atkins P.W; Paula J.De; Physical Chemistry, 8th Edn. Oxford University Press (2006).
7. Negi A.S., Anand S. C; A Textbook of Physical Chemistry, New Age International Publishers (2007).
8. Textbook of Organic Chemistry, Arun Bahl & B S Bahl, S. Chand Publishing, year-2019.
9. **Organic Chemistry** by Robert T. Morrison and Robert N. Boyd, Year- 2016

Reference Books (Practical)

1. Das R. C., Behra B., Experimental Physical Chemistry, Tata McGraw Hill.
2. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House.
3. Alexander Findlay, Levitt B. P., Findlay's Practical Physical Chemistry, Longman, London

SUBJECT: CHEMISTRY
B.Sc. –I SEMESTER - II
BCFS21: PAPER- I (ORGANIC CHEMISTRY)

Unit - I

(7.5 Hrs)

(A) Structure and Bonding: Hybridization in case of Methane, Ethane, Ethylene and Acetylene. Bond lengths, bond angles and bond energies. Elementary ideas of Inductive effect, Electromeric effect, Resonance effect, Hyperconjugation (definition and examples). Hydrogen bonding in organic compounds (with reference to alcohol and carboxylic acid) and its consequences.

(B) Mechanism of Organic Reactions: Homolytic and heterolytic bond fission with examples. Electrophiles and nucleophiles: Definition and example both neutral and charged. Types of organic reactions: Addition, substitution, elimination and rearrangement (Definition and examples). Reactive intermediates: Carbocations, carbanions, free radicals and carbenes (Definition, formation, geometry, stability).

Unit - II

(7.5Hrs)

(A) Stereochemistry of Organic Compounds: Concept of isomerism. Types of isomerism with examples. Optical isomerism: Elements of symmetry, molecular chirality, enantiomers, stereogenic centre (lactic acid as example). Optical activity, chiral and achiral molecules with two stereogenic centres (Tartaric acid as example), diastereo-isomers, meso-compound. Resolution of enantiomers: Biological and chemical methods. Inversion, retention, racemisation and asymmetric synthesis. Relative and absolute configuration. Sequence rules - D & L and R & S system of nomenclature.

(B) Geometrical isomerism: E and Z system of nomenclature, geometric isomerism in maleic acid, fumaric acid and 2-butene. **Conformational isomerism:** Conformational analysis of ethane and n-butane. Newman's projection and sawhorse formulae. Difference between Configuration and Conformation.

Unit – III

(7.5 Hrs)

(A) Alkanes: IUPAC nomenclature of alkanes (branched and unbranched). Alkyl group (definition and examples), methods of formation (Ethane and Propane): Wurtz reaction, Kolbe's reaction and decarboxylation of carboxylic acid. Physical properties and Chemical reactions of alkanes (Ethane and Propane): Halogenation, nitration, sulphonation, isomerization, cyclization, aromatization, and pyrolysis, cracking and oxidation. L. P. G., Octane number. Mechanism of free radical chlorination of methane.

Cycloalkanes: Nomenclature Introduction, Baeyer's strain theory and its limitations. Ring strain in small rings cyclopropane and cyclobutane. Theory of strained rings. Conformational analysis of cyclohexane, axial and equatorial bonds.

(B) Alkenes: IUPAC nomenclature of alkenes, methods of formation (ethylene and propylene): Dehydrogenation of alkanes, dehydrohalogenation of alkyl halides, dehydration of

alcohols and dehalogenation of dihalides. Chemical reactions of alkenes (ethylene and propylene):Hydroboration, oxidation KMnO_4 , HIO_4 , Epoxidation, Ozonolysis, Hydroxylation, Polymerization.Substitution in allylic position of alkenes.Markownikoff's rule and Peroxide effect. Ionic Mechanism of addition of Br_2 to ethene and HBr to propene, Free radical mechanism of addition of HBr to propene.

Unit - IV

(7.5 Hrs)

(A) Dienes: Nomenclature and classification of dienes. Methods of formation of 1,3-butadiene. Chemical reactions of butadiene: 1,2- and 1,4-additions. Diels-Alder reaction.

Alkynes: Nomenclature, structure and bonding in Alkynes.Methods of formation of acetylene from: Calcium carbide and dehydrohalogenation of dihalides. Chemical reaction: Hydroboration,oxidation, metal ammonia reduction and polymerization. Oxyacetylene flame and Acidity of alkynes.

(B) Aromatic Compounds and Aromaticity: Nomenclature of Benzene derivatives.Introduction,Structure of benzene - Molecular formula, Kekule structure, Resonance structure, MO picture, Huckel rule and aromaticity. Aromatic ions (cyclopentadienyl anion and cycloheptatrienyl cation). Aromatic electrophilic substitution mechanism with energy profile diagram (e.g. nitration and sulphonation).

Fuel Chemistry: LPG, CNG, LNG, and Bio-Gas (definition, calorific value, composition, properties and uses). Octane number.Lubricants:Definition, classification (solid, semisolid, liquid with example), properties (viscosity index, cloud point, pour point, acid value,saponification value) and applications of lubricants.

SUBJECT: CHEMISTRY

B.Sc. –I SEMESTER - II

BCFS22: PAPER- II (PHYSICAL CHEMISTRY)

Unit-I: Thermodynamics

7.5 Hrs

(A) Second law of thermodynamics, need for second law of thermodynamics, statements of second law of thermodynamics, Carnot's cycle and its efficiency, Carnot theorem, thermodynamic scale of temperature, concept of entropy, entropy change in reversible and irreversible processes, entropy change of the universe, entropy change for an ideal gas with change in P, V and T, entropy change during physical changes, Free energy functions: work function (A) and Gibb's free energy function (G), variation of work function with T and V, variation of Gibb's free energy with T and P, A and Gas criteria for spontaneity and equilibrium of a process, Gibb's-Helmholtz equation and its applications.

(B) Partial molar properties, chemical potential, Gibb's-Duhemequation, Clapeyron equation, Clapeyron- Clausius equation, chemical equilibrium: law of mass action, law of chemical equilibrium, relation between k_p and k_c , Van't- Hoff reaction isotherm, relation between standard free energy change and equilibrium constant, effect of temperature on equilibrium constant, integrated form of Van't Hoff equation. Numerical problems.

Unit-II: Phase Equilibria and Solutions of Liquids in Liquids

7.5 Hrs

(A) Phase rule, definitions and explanation of the terms: phase, components and degree of freedom, derivation of Gibb's phase rule, application of Phase rule to one component systems (i) water system and (ii) sulphur system, need of reduced phase rule equation, application of Phase rule to two component system: lead-silver system, Pattinson process for de-silverization of lead, Potassium iodide-water system.

(B) Solutions of liquids in liquids, Raoult's law, positive deviation from Raoult's law, negative deviation from Raoult's law, Henry's law, partially miscible liquids: lower and upper consolute temperature (examples of phenol-water, trimethylamine-water system, nicotine-water systems), effect of impurity on consolute temperature, Nernst distribution law, conditions for the validity of the distribution law, Applications of Nernst distribution law: association, dissociation and in the process of extraction, Numerical problems.

Unit-III: Chemical Kinetics and Theories of Reaction Rates

7.5 Hrs

(A) Rate of reaction, factors affecting the rate of reaction (concentration, temperature, pressure, solvent light and catalyst), order and molecularity of reaction, reactions of zero order, expression of the rate constant for the zero order reaction, derivation of integrated rate equation for first and second order reactions (both for equal and unequal concentration of reactants), characteristics of first and second order reactions, pseudounimolecular reactions, methods for determination of order of reactions: integration, differential, graphical, half life period, isolation methods.

(B) Theories of reaction rate: concept of energy of activation, Arrhenius equation, effect of temperature on rate of reaction, collision theory of bimolecular reactions (hard sphere model), transition state theory (equilibrium hypothesis), expression of rate constant based on

equilibrium constant and thermodynamic aspects, Lindemann theory of unimolecular reactions. Numerical problems.

Unit-IV: Nuclear Chemistry and Pollution and its Control

7.5 Hrs

(A) Nuclear chemistry: Radioactivity, stability of nucleus, rate of radioactive decay, mass defect and binding energy, average binding energy, explanation of nuclear stability on the basis of graph between binding energy per nucleon and atomic mass number, Nuclear reactions: fission and fusion, nuclear models: shell model and liquid drop model, comparison between shell model and liquid drop model, Bohr-Wheeler theory, radioisotopes, applications of radioisotopes in medicine, agriculture, industry and Carbon dating.

(B) Pollution and its control: Introduction, pollution, causes of pollution, segments of environment: lithosphere,

hydrosphere, biosphere and atmosphere, composition of atmosphere, atmospheric structure, air pollution, air pollutants like SO₂, SO₃, H₂S, NO, NO₂, CO, CO₂, and O₃, Acid rain, Greenhouse effect/Global warming, Particulates: dust, smoke, fly ash and smog: London smog and photochemical smog, Air pollution control, methods used to control gaseous pollutants: combustion, absorption and adsorption. Numerical problems.

BCFS23: LABORATORY COURSE

Practical - I (Organic Chemistry):

(A) Qualitative Analysis: Element detection(N, Cl, Br, F & S), Identification of functional groups (-COOH, Phenolic -OH, -CHO, Aromatic -NH₂, -CONH₂). Determination of M.P & B.P.

(B) Preparation:

- (i) Hydrolysis: Preparation of Benzoic acid from Benzamide
- (ii) Oxidation: Preparation of Benzoic acid from Benzaldehyde
- (iii) Bromination of Phenol.

Practical-II(Physical Chemistry)

1. To determine solubility of benzoic acid at different temperatures and hence determination of heat of solution of benzoic acid.
2. To determine heat of solution of solid calcium chloride and calculate lattice energy of calcium chloride from its enthalpy change data using Born-Haber cycle.
3. To construct phase diagram of three- component system (acetic acid-chloroform-water)
4. To determine critical solution temperature of two partially miscible liquids (phenol-water system).
5. To study the distribution coefficient of iodine between water and carbon- tetra chloride/kerosene.
6. To determine molecular state of benzoic acid in benzene by distribution method.
7. To determine rate constant of hydrolysis of methyl acetate in the presence of acid.
8. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH (Saponification of an ester)

Reference Books (Theory)

1. Barrow G. M; Physical Chemistry, Tata Mc Grow Hills (2007).
2. Castellan G. W; Physical Chemistry, Narosa (2004).
3. Puri B. R; Sharma L. R; Pathania M. S; Principles of Physical Chemistry, Vishal Publishing Company (2018).
4. GurdeepRaj, Advanced Physical Chemistry, Goel Publishing House (2009).
5. Bajpai D.N; Advanced Physical Chemistry, S. Chand and Compony Ltd. (2001).
6. Atkins P.W, and Paula J. De ; Physical Chemistry, 8th Edn. Oxford University Press (2006).
7. Negi A. S., Anand S. C., A Textbook of Physical Chemistry, New Age International Publishers (2007).
8. Dey A. K., Environmental Chemistry, New Age International Publishers (2019).
9. Dara S.S., A Text Book of Engineering Chemistry, S. Chand and Company Ltd.(2002).
10. Textbook of Organic Chemistry, Arun Bahl & B S Bahl, S. Chand Publishing, year-2019.
11. **Organic Chemistry** by Robert T. Morrison and Robert N. Boyd, Year- 2016

Reference Books (Practical)

1. Das R. C., Behra B., Experimental Physical Chemistry, Tata McGraw Hill.
2. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House.
3. Alexander Findlay, Levitt B. P., Findlay's Practical Physical Chemistry, Longman, London

SUBJECT: CHEMISTRY
B.Sc. –II SEMESTER - III
BCSS31: PAPER- I (INORGANIC CHEMISTRY)

Unit – I: **(7.5 Hrs)**

(A) Valence Shell Electron pair repulsion (VSEPR) Theory: Structure with respect to H₂O, NH₃, NH₄⁺, ClF₃, SF₄, ICl₄⁻. Preparation, properties and structure of Interhalogen compounds. Polyhalides (Structure of I₃⁻, I₅⁻, ICl₄⁻)

(B) MO theory: LCAO approximation, wave equation for molecular orbitals. Difference between bonding and anti bonding MO in terms of energy and electron density distribution curves, order of energy levels in MO. Molecular Orbital diagrams for homonuclear diatomic molecules of elements (with Z = 1 to 9). Concepts of nonbonding MO in HF molecule. Coulson's MO diagram of CO and NO diatomic molecule.

Unit- II: **(7.5 Hrs)**

A) Chemistry of elements of first transition series:

Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties, Colour, Complex formation tendency and catalytic activity.

(B) Chemistry of elements of second and third transition series:

Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d-analogous (Group Cr-Mo-W, Co-Rh-Ir,) in respect of oxidation states and magnetic behavior.

Unit III: **(7.5 Hrs)**

A) Errors in Chemical Analysis:

i) Random and Systematic errors, Explanation of terms: Accuracy and Precision, Uncertainty, Absolute and Relative errors, Mean, Median, Average and Standard deviations, Significant figures, numerical problems.

ii) Statistical Test of Data: Q-test, 2.5d and 4d Rules for rejection of data. Numerical problems.

B) Non-aqueous solvents:

Classification of solvents and characteristic reactions (acid base, redox & precipitation reactions) in Non-aqueous solvents with reference to i) Liquid Ammonia and ii) Liquid Sulphur dioxide.

Unit – IV: **(7.5 Hrs)**

A) Chemistry of Lanthanides:

Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii, Lanthanide contraction and its consequences, Complex forming tendency. Occurrence and separation of lanthanides (ion exchange and solvent extraction).

B) Chemistry of Actinides:

Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii. Actinide contraction.

SUBJECT: CHEMISTRY
B.Sc. –II SEMESTER - III
BCSS32: PAPER- II (ORGANIC CHEMISTRY)

Unit –I **(7.5 Hrs)**

Orientation: Activating ($-\text{OH}$, $-\text{NH}_2$) & deactivating ($-\text{Cl}$, $-\text{NO}_2$, $-\text{COOH}$) substituent's, their orientation and directive influence on further electrophilic substitution, o/p ratio. Methods of formation and chemical reactions of alkyl benzene (Toluene) and biphenyl.

Alkyl halides: Nomenclature, classification, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides SN^1 and SN^2 with energy profile diagrams.

Polyhalogen compounds: Chloroform and carbon tetrachloride – formation and chemical reactions.

Nuclear and side chain halogen derivatives of benzene (Aryl halides): Chlorobenzene and benzyl chloride preparation and reactions. Relative reactivity of alkyl halides vs aryl halides. Synthesis and uses of DDT and BHC.

Unit – II **(7.5 Hrs)**

A) Alcohols: Classification and nomenclature,

Dihydric alcohols: Nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage ($\text{Pb}(\text{OAc})_4$ and HIO_4) and Pinacol – pinacolone rearrangement with mechanism.

Trihydric alcohols : Nomenclature and methods of formation of Glycerol from (i) Propene and (ii) Hydrolysis of oils and fats, chemical reactions of glycerol - with oxalic acid at two different temperatures, HI , HNO_3 , dehydration.

(B) Phenols: Nomenclature, structure and bonding. Preparation of phenols from cumene, chlorobenzene (Dows and Raschig process) and diazonium salts. Physical properties and acidic character, Resonance stabilization of phenoxide ion, Reactions of phenols, Electrophilic aromatic substitution, acetylation and carboxylation, Claisen rearrangement, Gatterman synthesis, Reaction Mechanism of i) Fries Rearrangement, ii) Reimer-Tiemann reaction.

Unit – III **(7.5 Hrs)**

Aldehydes and ketones: Nomenclature, structure of the carbonyl group, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides and ketones from nitriles.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, aldol, Perkin and Knoevenagel condensation. Wittig reaction, Mannich reaction, oxidation of aldehydes (by KMnO_4 , Tollen's reagent and Fehling's solution), Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, (with mechanism), MPV, Clemmensen, Wolf-Kishner, LiAlH_4 and NaBH_4 reductions.

Unit IV

(7.5 Hrs)

A) Carboxylic Acids: Nomenclature, structure & bonding. Physical properties, acidity of carboxylic acids, effect of substituent's on acid strengths, preparation of carboxylic acids (from Grignard Reagent and cyanides), Reactions of carboxylic acids, Hell-Volhard-Zelinsky reactions. Reduction of carboxylic acids, Mechanism of decarboxylation with soda lime. Methods of formation and chemical reactions of unsaturated monocarboxylic acids (crotonic acid and cinnamic acid).

Dicarboxylic acids: Methods of formation of succinic acid from ethylene dibromide and Phthalic acid from o-xylene. Effect of heat and dehydrating agents. (Succinic acid, Phthalic acid).

(B) Carboxylic acid derivatives : Structure & nomenclature of acid chlorides, esters, amides and acid anhydrides. Interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, Chemical reactions, Mechanism of esterification and hydrolysis (acidic and basic).

BCSS33: LABORATORY COURSE

Practical-I (Inorganic Chemistry):

Volumetric Analysis (All 5 Expts. to be performed)

Preparation of standard solution by weighing is compulsory

- 1) Estimation of Fe(II) by dichromate using internal indicator.
- 2) Determination of acetic acid in commercial vinegar using NaOH
- 3) Determination of alkali content in antacid tablet using HCl
- 4) Determination of Zn by complexometric titration with EDTA
- 5) Determination of total Hardness of water (permanent and Temporary) by EDTA

Practical- II(Organic Chemistry):

Complete analysis of simple organic compound involving following steps :-

- (i) Preliminary examination
- ii) Detection of elements
- iii) Detection of functional group
- iv) Determination of M.P. / B.P.
- v) Preparation of derivative and its M.P./B.P.
- vi) Performance of specific test if any

References

1. Concise Inorganic Chemistry By J.D. Lee
2. Inorganic Chemistry by Peter, Atkins Tina Overton, Jonathon Rourke
3. Organic Chemistry by J Clayden, N Greeves, S Warren, P Wothers
4. Organic Chemistry, Volume 1 by N Finar
5. Organic Chemistry, Volume 2 by N Finar
6. Textbook of Organic Chemistry, Arun Bahl & B S Bahl, S. Chand Publishing, year- 2019.
7. **Organic Chemistry** by Robert T. Morrison and Robert N. Boyd, Year- 2016

Reference Books (Practical)

1. Practical Inorganic Chemistry by GEOFFREY PASS and HAYDN SUTCLIFFE
2. Advanced Practical Organic Chemistry, Second Edition By John Leonard, Barry Lygo, Garry Procter

SUBJECT: CHEMISTRY
B.Sc. –II SEMESTER - IV
BCSS41: PAPER- I (INORGANIC CHEMISTRY)

Unit-I: (7.5 Hrs)

Coordination compounds:

Distinction among simple salts, double salts and coordination compounds. Werner's Coordination theory and its experimental verification. Sidgwick's electronic interpretation, EAN rule with examples, Nomenclature of Coordination compounds. Chelates: Classification and their application, Valence Bond Theory of transition metal complexes.

Unit- II: (7.5 Hrs)

A) Isomerism in coordination compounds:

Structural isomerism and Stereoisomerism in coordination compounds with respect to C.N. 4 & 6

B) Oxidation and reduction:

Concept of oxidation and reduction. Balancing of redox reactions by Electron method numerals. EMF series and its applications. Use of redox potential data: Analysis of Redox cycle, redox stability in water, Latimer diagram of Chlorine and Oxygen, Construction and explanation of Frost diagram. Frost diagram of Nitrogen and Oxygen. Pourbaix diagram of Iron.

Unit- III: 7.5 Hrs

A) Colorimetry and Spectrophotometry:

Principles of photometry: Beer-Lambert's Law, derivation and deviation (Numericals). Types of colorimeter and spectrophotometer with simple schematic diagrams. Application of colorimeter and spectrophotometer in quantitative analysis with reference to estimation of Cu(II) as Cu-ammonia complex.

B) Separation Techniques:

- a) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography.
- b) Ion-Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures.
- c) Solvent Extraction: Principle and Classification, Factors influencing extraction and application in chemistry.

Unit- IV Inorganic Polymers: (7.5 Hrs)

Silicones: Introduction, Nomenclature, preparation, properties and uses, General introduction to Silicon oils, Silicone Elastomers and Silicon Resins

Phosphonitrilic halide polymers: Introduction, Preparation, properties and uses. Structure and bonding in $(NPCl_2)_3$ and $(NPCl_2)_4$

SUBJECT: CHEMISTRY
B.Sc. –II SEMESTER - IV
BCSS42: PAPER- II (PHYSICAL CHEMISTRY)

Unit-I Solid State

(7.5Hrs)

Solids and their classification, Difference between crystalline and amorphous solids, classification of crystalline solids. Laws of crystallography: Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry, elements of a crystal. Space lattice, Unit cell, Bravais lattices, crystal systems, identification of crystal planes, interplanar distance in cubic systems, X-ray diffraction by crystal, derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl, Laue's method and powder method.

UNIT –II: Electrochemistry

(7.5Hrs)

A) Electrical transport : Conductance in metals (electronic) & in electrolyte solutions (ionic conductance), specific, equivalent and molar conductance, measurement of electrolytic conductance, variation of equivalent, specific & molar conductance with dilution, Kohlrausch's law, Arrhenius theory of electrolyte dissociation & its limitation, Ostwald's dilution law, validity and importance of Ostwald's dilution law.

Debye-Huckel theory (elementary treatment). Relaxation effect, Electrophoretic effect, Onsager equation.

B) Transport number, determination of transport number by Hittorf's method & moving boundary method, factors affecting transport number of ions, relation between ionic conductance & transport number. Applications of Kohlrausch's law & conductance measurements: determination of equivalent conductance at infinite dilution for weak electrolytes, determination of degree of dissociation, determination of solubility and solubility product of sparingly soluble salts. Conductometric titrations (Acid-base & precipitation titrations). Numerical problems.

Unit-III: Spectroscopy

(7.5 Hrs)

A) Rotational Spectroscopy: Rotational spectra of diatomic molecules, Energy levels of rigid rotor. Selection rule for transition between energy levels. Expression for wave number of spectral lines in terms of rotational constant (B) and rotational quantum number (J). Intensity of spectral lines. Types of molecules showing rotational spectra. Application of rotational spectra for determination of moment of inertia and bond length. Introduction to non-rigid rotor.

B) Vibrational Spectra:

Vibrational energy levels of simple harmonic oscillator, selection rules. Types of molecules showing vibrational spectra. Vibrational energy level of anharmonic oscillator, selection rule, idea of overtones. Vibrational – Rotational spectra. P, Q and R branches of the vibrational – rotational spectra. Structural information from infrared spectra. Numerical problems.

Unit IV: Quantum Chemistry I**(7.5 Hrs)**

A) Failure of classical mechanics, Explanation of Black body radiation, Photoelectric effect, and heat capacity of solids on the basis of classical mechanics. Bohr's model of Hydrogen atom, spectrum of hydrogen atom, Planck's quantum theory. De Broglie's hypothesis (Derivation and experimental proof). Heisenberg's uncertainty principle (Explanation and experimental proof).

B) Introduction to wave functions (Ψ), Schrodinger wave equation. Eigen values and Eigen functions, well behaved wave functions. Interpretation of wave function (Ψ) and its square (Ψ^2), Normalized and orthogonal wave functions. Postulates of quantum mechanics, Derivation of Schrodinger wave equation from postulates of quantum mechanics. Application of Schrodinger wave equation for a particle in one dimensional box and three dimensional box. Concept of degeneracy. Numerical problems.

BCSS43: LABORATORY COURSE

Practical-I (Inorganic Chemistry):

A) Preparation of following complexes and Comments on its VBT structure, magnetic properties and colors

- a) $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{SO}_4$ b) $[\text{Ni}(\text{NH}_3)_6]\text{SO}_4$ c) Trans $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
d) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3] \cdot \text{H}_2\text{O}$

B) **Chromatographic separation** of binary mixtures(at least Two) containing Cu(II), Co(II) and Ni(II) ions by paper chromatography and determination of R_f values.

Practical-II (Physical Chemistry):

1. To construct various crystal lattices.
2. To determine the strength of the given acid (HCl or CH₃COOH) conductometrically using standard alkali (NaOH) solution.
3. To determine the strength of strong acid and a weak acid in a given mixture conductometrically against a standard alkali solution.
4. To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
5. To determine the ionization constant of weak acid conductometrically.
6. To determine heat of solution of solid calcium chloride and calculate lattice energy of calcium chloride from its enthalpy change data using Born-Haber cycle.
7. To determine the molar volume of ethanol at room temperature in dilute aqueous solution
8. To determine the equilibrium constant of the reaction, $\text{KI} + \text{I}_2 \rightleftharpoons \text{KI}_3$ by distribution method.

(At least six experiments to be performed)

References (Theory)

1. Concise Inorganic Chemistry By J.D. Lee
2. Inorganic Chemistry by Peter, Atkins Tina Overton, Jonathon Rourke
3. Barrow G. M; Physical Chemistry, Tata Mc Grow Hills (2007).
4. Castellan G. W; Physical Chemistry, Narosa (2004).
5. Puri B. R; Sharma L. R; Pathania M. S; Principles of Physical Chemistry, Vishal Publishing Company (2018).
6. GurdeepRaj, Advanced Physical Chemistry, Goel Publishing House (2009).
Bajpai D.N; Advanced Physical Chemistry, S. Chand and Compony Ltd. (2001).
7. Atkins P.W, and Paula J. De ; Physical Chemistry, 8th Edn. Oxford University Press (2006).
8. Negi A. S., Anand S. C., A Textbook of Physical Chemistry, New Age International Publishers (2007).
9. Fundamentals of Molecular SpectroscopyBy Colin Neville Banwell, Elaine M. McCash
10. Physical chemistry : a molecular approachBy Donald A. McQuarrie, John D. Simon, Heather A. Cox, hn D. Simon.
11. Textbook of Organic Chemistry, Arun Bahl & B S Bahl, S. Chand Publishing, year-2019.
12. **Organic Chemistry** by Robert T. Morrison and Robert N. Boyd, Year- 2016

13. Reference Books (Practical)

1. Das R. C., Behra B., Experimental Physical Chemistry, Tata McGraw Hill.
2. 2. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House.
3. 3. Alexander Findlay, Levitt B. P., Findlay's Practical Physical Chemistry, Longman, London
4. Practical Inorganic Chemistry by GEOFFREY PASS and HAYDN SUTCLIFFE

SUBJECT: CHEMISTRY
B.Sc. –III SEMESTER - V
BCTS51: PAPER- I (ORGANIC CHEMISTRY)

UNIT- I
(7.5 Hrs)

Organic compounds of Nitrogen :Preparation of nitroalkanes and nitrobenzene, chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitrobenzene and their reduction in acidic, neutral and alkaline media. Picric acid- preparation and uses,

Amines :Structure and nomenclature of amines, Physical properties, stereochemistry of amines, separation of mixture of 1°, 2° and 3° amines by Hoffmann's method, structural features affecting basicity of amines, preparation of alkyl &aryl amines (reduction of nitro compounds and nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel phthalimide reaction, Hofmann bromamide reaction, Reactions of amines, Preparation and synthetic transformations of aryl diazonium salts.

UNIT – II - HETEROCYCLIC COMPOUNDS: (7.5 Hrs)

Molecular orbital picture and aromaticity of furan, thiophene, pyrrole and pyridine.Methods of synthesis of pyridine (i) from hexamethylenediamine and (ii) Picoline.Mechanism of electrophilic and nucleophilic substitution reaction of pyridine.Chemical reaction of pyridine.Structure of pyridine.Comparison of basicity of pyrrole and pyridine.Introduction to condensed five and six membered heterocycles.Preparation and reactions of Indole, Quinoline and Isoquinoline with special reference to Fischer Indole synthesis, Skraup synthesis and BischlerNapieralski synthesis.

UNIT-III (7.5 Hrs)

A) Quantitative Analysis :Estimation of carbon, hydrogen, nitrogen, sulphur and halogens (only principles and calculations). Calculation of Empirical and molecular formula with Numericals

B) Organometallic compounds :

Organomagnesium compound : Grignard reagent formation, chemical reactions and structure.
Organozinc compounds : Formation and chemical reactions. Organolithium compounds: Formation and chemical reactions.

UNIT-IV - SPECTROSCOPY : (7.5 Hrs)

A) Electromagnetic spectrum :Absorption spectra, Ultraviolet absorption spectroscopy, Absorption laws(Beer Lambert law), molar absorptivity, Presentation and analysis of UV spectra, Types of electronic transitions, Effect of conjugation, concept of chromophores and auxochromes, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated dienes and enones.

B) Infrared (IR) absorption spectroscopy :Molecular vibrations, Hook's law, Selection rules, Intensity and position of IR bands, measurement of IR spectrum. Fingerprint region, characteristic absorptions of various functional groups and application of IR spectra.

SUBJECT: CHEMISTRY
B.Sc. –III SEMESTER - V
BCTS52: PAPER- II (PHYSICAL CHEMISTRY)

Unit –I Electrochemistry

(7.5 Hrs)

(A) Galvanic cells, irreversible & reversible cells, emf of cell & its measurement, relation between electrical energy and chemical energy, calculation of thermodynamic quantities of a cell reactions (ΔG , ΔH & ΔS & equilibrium constant)

(B) Types of reversible electrodes : metal-metal ion electrode, gas electrode, metal insoluble salt-anion electrode, redox electrodes, amalgam electrode, Nernst equation, calculation of cell emf from single electrode potential, reference electrodes, standard electrode potential, concentration cells with & without transference, liquid-junction potential, salt bridge & its functions. Applications of emf measurements in : (i) pH- determination using hydrogen electrode, quinhydrone electrode & glass electrode (ii) Potentiometric titration (Acid –Base and Redox titrations). Numericals Problems.

Unit II : Quantum Chemistry and Molecular Orbital Theory:

(7.5 Hrs)

A) **Quantum Chemistry** Schrodinger wave equation for H-atom, separation in to three equations (without derivation), quantum numbers and their importance, Hydrogen like wave functions, radial wave functions and angular wave functions. Concept of orbital, shapes of orbital. Radial probability distribution curves for 1s, 2s, 2p, 3p and 3d orbitals.

B) **Molecular orbital theory** : Born-Oppenheimer approximation, Criteria for forming M. O. from A. O., LCAO-MO method for H_2^+ ion, Physical pictures of bonding and antibonding wave functions. Calculation of energy from wave functions. Comparison of bonding and antibonding molecular orbitals. Introduction to M. O. theory for H_2 molecule. Introduction to Valence bond theory for H_2 molecule. Similarities and differences of valence bond and molecular orbital models.

Unit III: Photochemistry and Raman Spectroscopy

(7.5 Hrs)

A) Photochemistry :

Interaction of radiation with matter, difference between thermal and photochemical reactions, Laws governing absorption of light. Laws of photochemistry. Jablonski diagram depicting various processes, quantum yield, determination of quantum yield of reactions, reasons for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCl from H_2 and Cl_2) Photosensitization, Photosensitized reactions. Numericals Problems.

B) Raman Spectroscopy :

Raman Effect, explanation of Rayleigh's lines, Stoke's lines and antistoke's lines, Experimental set up of Raman spectrometer. Pure rotational Raman spectra of diatomic molecules, rotational-vibration Raman spectra of diatomic molecules. Advantages of Raman spectroscopy over Infra red spectroscopy.

UNIT-IV: Colligative properties and Macromolecules**(7.5 Hrs)**

A) Colligative properties: Methods of expressing concentration of solutions, Raoult's law, Relative lowering of vapour pressure, determination of molecular mass from relative lowering of vapour pressure. Osmosis and osmotic pressure of solution. Measurement of osmotic pressure by Barkeley and Hartley method. Determination of molecular mass from osmotic pressure. Elevation of boiling point of solvent, determination of molecular mass from elevation of boiling point. Depression of freezing point of the solvent. Determination of molecular mass from depression of freezing point. Van't Hoff factor, degree of dissociation and association of solute.

B) Macromolecules: Macromolecules, classification of polymers, molar masses of polymers: number average and weight average molar masses, determination of molar masses of macromolecules: viscometry, Osmometry and light scattering method. Kinetics of polymerization, addition and condensation polymerization. Electronically conducting polymers: poly(acetylene) poly(sulphyrnitride), poly(para-phenylene), poly(aniline). Numericals Problems.

BCTS53: LABORATORY COURSE

Practical I (Organic Chemistry):

Estimations

- i) Estimation of Glucose
- ii) Estimation of Amide
- iii) Estimation of Nitro group
- iv) Estimation of Carboxylic group
- v) Saponification of oil

Practical II (Physical Chemistry):

1. To determine the strength of given acid (HCL or CH₃COOH) potentiometrically using standard alkali solution
2. To determine the dissociation constant of weak acid potentiometrically by titrating it against alkali.
3. To titrate potentiometrically ferrous ammonium sulphate against potassium dichromate and calculate redox potential of Fe²⁺/Fe³⁺ system.
4. To verify Beer-Lambert law using calorimeter and determine the concentration of given solution.
5. To determine molecular mass of a non-volatile solute by Rast method.
6. To determine the molecular weight of polymer by Viscometric method.
7. To determine the specific rotation of a given optically active compound and the concentration of an unknown solution polarimetrically.
8. To study the rate of acid catalysed iodination of acetone.

(At least six experiments to be performed)

Reference Books (Theory)

1. Barrow G. M; Physical Chemistry, Tata Mc Grow Hills (2007).
2. Castellan G. W; Physical Chemistry, Narosa (2004).
3. Puri B. R; Sharma L. R; Pathania M. S; Principles of Physical Chemistry, Vishal Publishing Company (2018).
4. GurdeepRaj, Advanced Physical Chemistry, Goel Publishing House (2009).
5. Bajpai D.N; Advanced Physical Chemistry, S. Chand and Compony Ltd. (2001).
6. Atkins P.W, and Paula J. De ; Physical Chemistry, 8th Edn. Oxford University Press (2006).
7. Negi A. S., Anand S. C., A Textbook of Physical Chemistry, New Age International Publishers (2007).
8. Dey A. K., Environmental Chemistry, New Age International Publishers (2019).
9. Dara S.S., A Text Book of Engineering Chemistry, S. Chand and Company Ltd.(2002).
10. OrganicChemistry by J Clayden, N Greeves, S Warren, P Wothers
11. Organic Chemistry, Volume 1 by N Finar
12. Organic Chemistry, Volume 2 by N Finar
13. Textbook of Organic Chemistry, Arun Bahl & B S Bahl, S. Chand Publishing, year-2019.
14. Organic Chemistry by Robert T. Morrison and Robert N. Boyd, Year- 2016

Reference Books (Practical)

1. Das R. C., Behra B., Experimental Physical Chemistry, Tata McGraw Hill.
2. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House.
3. Alexander Findlay, Levitt B. P., Findlay's Practical Physical Chemistry, Longman, London
4. Advanced Practical Organic Chemistry, Second Edition By John Leonard, Barry Lygo, Garry Procter

SUBJECT: CHEMISTRY
B.Sc. –III SEMESTER - VI
BCTS61: PAPER- I (INORGANIC CHEMISTRY)

Unit- I

A) Metal ligand bonding in Transition Metal Complexes: (7.5 Hrs)

Limitations of Valence bond theory, Crystal field theory: Splitting of d-orbital in octahedral, tetrahedral and square planar complexes. Factors affecting the Magnitude of $10 Dq$. Concept of Crystal field Stabilisation Energy of octahedral and tetrahedral complexes. High spin low spin complexes on the basis of Δ_o and pairing energy in octahedral complexes. (Numericals)

B) Electronic spectra of Transition Metal Complexes:

Jahn-Teller Effect, Conditions of distortion with respect to CFT configuration. Selection Rules (Laporte and Spin selection Rules). Hole Formalism Principle with respect to d1 and d9 ions. Electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ complex ions with respect to position of the band, intensity of the band, symmetry of the band and bandwidth.

Unit-II: (7.5 Hrs)

A) Magnetic Properties of Transition Metal Complexes:

Method of determination of Magnetic Susceptibility by Gouy's Method. Spin only formula and orbital contribution to magnetic moment. Magnetic properties of Octahedral and Tetrahedral complexes with respect to CFT. Numericals on magnetic moments.

B) Thermodynamic and Kinetic aspect of metal complexes:

Thermodynamic and Kinetic stability of metal complexes, their relation. Stepwise stability and overall stability constant and their relationship, Factors affecting the Stability of complexes. Determination of composition of Fe(III)-SSA complex by Mole Ratio and Job's Method.

Unit III: (7.5 Hrs)

A) Organometallic Chemistry

Definition, Nomenclature and Classification of Organometallic compounds. Preparation properties and application of Alkyl and Aryls of Li and Al. A brief account of metal ethylenic complexes (Structure only). Homogeneous Hydrogenation (Wilkinson's Catalyst reaction).

B) Metal carbonyls: Definition, preparation, properties. Structure and bonding in mononuclear carbonyls- $\text{Ni}(\text{CO})_4$, $\text{Fe}(\text{CO})_5$ and $\text{Cr}(\text{CO})_6$ with respect to back π -bonding.

Unit –IV: (7.5 Hrs)

A) Bioinorganic Chemistry: Essential and Trace elements in biological processes, Metalloporphyrins with special reference to structure and role of Haemoglobin and Myoglobin in transport of Oxygen. Biological role of Na^+ and K^+ and Ca^{2+} metal ions. Sodium and potassium pump. Hypo and hyper calcimia. Calcium triggering and calcium pump.

B) Hard and Soft Acids and Bases: Classification of Acids and Bases as Hard and Soft. Pearson's HSAB Concept and its applications. Symbiosis, Antagonism.

SUBJECT: CHEMISTRY

B.Sc. –III SEMESTER - VI

BCTS62: PAPER- II (ORGANIC CHEMISTRY)

UNIT- I : NMR Spectroscopy: (7.5 Hrs)

Nuclear Magnetic Resonance (NMR) spectroscopy. Proton Magnetic Resonance spectroscopy. Nuclear shielding and deshielding, chemical shift, Spin-spin splitting and Coupling constant. Areas of signals. Interpretation of NMR spectra of organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,2 dibromoethane, ethyl acetate, toluene, acetophenone, acetyl acetone. Problem pertaining to the structure elucidation of simple organic molecules by NMR technique.

UNIT- II (7.5 Hrs)

A) ORGANIC SYNTHESIS VIA ENOLATES:

Acidity of α - hydrogens, Reactivity of methylene group. Malonic ester preparation and reaction- Acetoacetic ester - synthesis by Claisen condensation reactions, Keto - enol tautomerism of acetoacetic ester, Preparation of acetic acid, succinic acid, crotonic acid and heterocyclic compounds.

B) CARBOHYDRATES: Definition, classification and reaction of glucose. Mechanism of osazone formation. Determination of structure of glucose. Determination of ring size of monosaccharides. Epimerisation, mutarotation, conversion of glucose into fructose and vice-versa. Chain lengthening and shortening of aldoses (Wohl's degradation). Introduction to structures of maltose, sucrose, lactose, starch, cellulose, ribose and deoxyribose without involving structure determination.

UNIT-III (7.5 Hrs)

A) AMINO ACIDS, PEPTIDES, PROTEINS & NUCLEIC ACIDS:

Classification, structure and stereochemistry of amino acids. Acids base behavior, isoelectric point and electrophoresis. Structure and nomenclature of peptides and protein. Classification of proteins. Protein denaturation. Structure determination of proteins (primary and secondary).

NUCLEIC ACIDS: Introduction, constituents of nucleic acids. Ribonucleosides and Ribonucleotides. Double helical structure of DNA.

B) FATS, OILS AND DETERGENTS : Natural fats, edible and industrial oils of vegetable origin, Glycerides, hydrogenation of unsaturated oils, Definition of Saponification value, Iodine value, Acid value, Soaps, Synthetic detergents, Alkyl and aryl sulfonates.

UNIT- IV (7.5 Hrs)

A) SYNTHETIC DYES: Colour and constitution (Witt theory, electronic concept) Classification of Dyes based on chemical constitution. Synthesis and uses of Congo red, Crystal violet, Phenolphthalein and Alizarin dye.

B) SYNTHETIC DRUGS: Definition, Classification, Preparation, properties and uses of: Aspirin, acetamol, Dettol, Chloroquine, Phenobarbitone, Chloramphenicol, Chloramine T.

C) SYNTHETIC POLYMERS: Addition or chain growth polymerization, free radical. Vinyl polymerization, Ionic vinyl polymerization, Ziegler - Natta polymerization .Condensation or step growth polymerization. Polyesters, polyamides,

BCTS63: LABORATORY COURSE

Practical-I (Inorganic Chemistry):

A) Gravimetric Analysis

- i) Estimation of Ba^{2+} as BaSO_4 ,
- ii) Estimation Ni^{2+} as Ni-DMG

B) Colorimetry

- i) Colorimetric or spectrophotometric estimation of copper (II) in commercial copper sulphate sample as ammonia complex.
- ii) Jobs method of determination of composition of Fe- SSA complex
- iii) Mole Ratio Method of determination of composition of Fe- SSA complex

Practical-II (Organic Chemistry):

Separation of an organic mixture containing two solid components using NaOH / NaHCO_3 for separation, identification of the components and preparation of suitable derivatives (minimum five mixtures)

Reference Books (Theory)

1. Concise Inorganic Chemistry By J.D. Lee
2. Inorganic Chemistry by Peter, Atkins Tina Overton, Jonathon Rourke
3. Practical Inorganic Chemistry by GEOFFREY PASS and HAYDN SUTCLIFFE
4. Organic Chemistry by J Clayden, N Greeves, S Warren, P Wothers
5. Organic Chemistry, Volume 1 by N Finar
6. Organic Chemistry, Volume 2 by N Finar
7. Introduction to Spectroscopy By Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan
8. Textbook of Organic Chemistry, Arun Bahl & B S Bahl, S. Chand Publishing, year- 2019.
9. Organic Chemistry by Robert T. Morrison and Robert N. Boyd, Year- 2016

Reference Books (Practical)

1. Advanced Practical Organic Chemistry, Second Edition By John Leonard, Barry Lygo, Garry Procter