

MAULANA AZAD UNIVERSITY, JODHPUR

B.Sc. CHEMISTRY SYLLABUS

| CODE | DESCRIPTION | PD/W | EXAM | CIA | ESE | TOTAL |
|--------------|-------------------------|------|--------|-----|-----|-------------|
| BSCH111 | INORGANIC CHEMISTRY-I | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH112 | ORGANIC CHEMISTRY-I | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH121 | LABORATORY COURSE-I | 6 | 3 hrs. | 20 | 80 | 100 |
| | | | | | | |
| BSCH211 | PHYSICAL CHEMISTRY-I | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH212 | ORGANIC CHEMISTRY-II | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH221 | LABORATORY COURSE-II | 6 | 3 hrs. | 20 | 80 | 100 |
| | | | | | | |
| BSCH311 | INORGANIC CHEMISTRY-II | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH312 | PHYSICAL CHEMISTRY-II | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH321 | LABORATORY COURSE-III | 6 | 3 hrs. | 20 | 80 | 100 |
| | | | | | | |
| BSCH411 | INORGANIC CHEMISTRY-III | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH412 | ORGANIC CHEMISTRY-III | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH421 | LABORATORY COURSE-IV | 6 | 3 hrs. | 20 | 80 | 100 |
| | | | | | | |
| BSCH511 | ORGANIC CHEMISTRY-IV | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH512 | PHYSICAL CHEMISTRY-III | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH521 | LABORATORY COURSE-V | 6 | 3 hrs. | 20 | 80 | 100 |
| | | | | | | |
| BSCH611 | INORGANIC CHEMISTRY-IV | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH612 | PHYSICAL CHEMISTRY-IV | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH621 | LABORATORY COURSE-VI | 6 | 3 hrs. | 20 | 80 | 100 |
| TOTAL | | | | | | 1800 |

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B.Sc - IST SEMESTER CHEMISTRY

| CODE | DESCRIPTION | PD/W | EXAM | CIA | ESE | TOTAL |
|-------------|-----------------------|------|--------|-----|-----|-------|
| BSCH1111 | INORGANIC CHEMISTRY-I | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH1112 | ORGANIC CHEMISTRY-I | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH1121 | LABORATORY COURSE-I | 6 | 3 hrs. | 20 | 80 | 100 |
| Grand Total | | | | | | 300 |

BSCH111- INORGANIC CHEMISTRY-I

UNIT-I: ATOMIC STRUCTURE

Wave partical duality: de Broglie's concept of matter waves, DavisionGermerExperiment& explanation of Bohr's quantum restriction, Heisenberg's uncertainty principle & its significance.

Wave Mechanical Model of Atom: Schrödinger's wave equation, eign value & eign function, physical significance of wave function, concept of orbital, quantum numbers & their significance, radial and angular wave functions and probabality distribution curves, shapes of s, p, and d orbitals.

Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principal & its limitations. Electronic configurations of the elements, effective nuclear charge & their calculation using Slater's rule.

UNIT-II: PERIODIC TRENDS OF DIFFERENT PROPERTIES

Periodic trends of following properties with refrence to s & p block elements

Atomic and ionic radii: covalent, metallic & Vander Waal's radii, determination of ionic radii using X-ray electron density maps, Lande's method, Pauling method

Ionization enthalpy: definition, successive ionization enthalpies, factors affecting their values and applications of ionization enthalpy.

Electron Affinity: definition, successive values of electron gain enthalpy factors affecting their values and application of electron affinity.

Electronegativity: Definition, Pauling's, Mulliken's, Allred Rachow's and Mulliken-Jaffe's electronegativity scale, method of determination and applications.

UNIT-III: IONIC BONDING

Energetics of crystal formation: Lattice enthalpy, Experimantal determination of Lattice Energy Born-Haber cycle and its application, caculation of lattice enthalpies: Born-Lande's equation, Madelung Constant, Kapustinki equation, factors affecting lattice enthalpy and consequences of lattice enthalpies: thermal stability of ionic soloids, stability of oxidation states and solubility of ionic compounds.

Radius ratio: Radius ratio effect and coordination number, calculation of limiting radius ratio values for coordination number 3, 4 & 6, limitation of radius ratio rule.

Covalent character in ionic bond: polarizing power and polarizability of ions, Fajan's rule and their application.

UNIT-IV: WEAK INTERACTIONS & METALLIC BONDING

Hydrogen bonding: Types of hydrogen bond, symmetrical and unsymmetrical H bonding, H-bond energy and bond length, effects of Intermolecular and intramolecular H-bond on physiochemical

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properties, theories of hydrogen bonding: electrostatic, VBT & MOT and consequences of hydrogen bonding.

Vander Waal forces of interactions: Attractive intermolecular forces: dipole-dipole, dipole induced dipole and instantaneous dipole induced dipole interactions, repulsive inter molecular forces of interactions. Interaction between ionic and covalent compounds: ion-dipole and ion-induced dipole interactions.

Metallic bonding: theories of metallic bond: classical free electron theory and metallic properties, valence bond theory and band theory and physical properties.

UNIT-V: S-BLOCK

Physical properties: Flame colouration, reducing tendency

Chemical properties: diagonal relationship, solvation and complexation tendencies

Hydrides: classification, preparation properties and uses of s-block elements and Lithium aluminium Hydride.

Industrial uses of s-block elements: Portland cement: raw material, composition of cement, methods of preparation, setting and hardening of cement.

Glass: raw material, methods of manufacturing, types and their uses.

SUGGESTED READINGS:

1. Principles of Inorganic Chemistry by B.R.Puri, L.R.Sharma and Kalia.
2. Advanced Inorganic Chemistry, vol I, by Satyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan.
3. Selected Topics in Inorganic Chemistry by Wahid.U.Malik, G.D.Tuli, R.D.Madan.
4. Fundamental concepts of Inorganic Chemistry, vol.I, by Asim.K.Das.
5. Inorganic Chemistry, vol I by Ameta, Daga, Sharma and Mehta. , Himanshu publication (Hindi)
6. Inorganic Chemistry, vol I by Ojha ,Chaturvedi, Ramesh book depot (Hindi& English)

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BSCH112-ORGANIC CHEMISTRY-I

UNIT-I: STRUCTURE AND BONDING

Hybridizations, Bond lengths and bond angles, bond energy: Localized and delocalized chemical bond, van-der Waals interactions, resonance, hyperconjugation, inductive and field effects, formal charge, polar covalent bond

UNIT-II: MECHANISM OF ORGANIC REACTIONS

Curved arrow notations, drawing electron movement with arrows, half headed and double headed arrow, homolytic and heterolytic bond breaking.

Types of Reagents

Electrophiles and nucleophiles, types of organic reactions, Energy consideration, Reactive intermediates: carbocations, carbanions, free radicals, carbenes, benzyne and nitrene. Methods of determination of reaction mechanism: Product analysis, intermediates, isotopic labeling, Stereochemical studies and kinetic studies.

UNIT-III: STEREOCHEMISTRY – I

Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogeniccentres, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, distereoisomers, mesocompounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configurations, sequence rules, D & L, R & S systems of nomenclature.

UNIT-IV: STEREOCHEMISTRY – II

Nomenclature E and Z system, geometrical isomerism in alicyclic compounds and oximes, determination of configuration of geometrical isomers. Conformation: conformational analysis of ethane and n-butane. Conformations of cyclohexanes and monosubstituted cyclohexane derivatives axial and equatorial bonds, Newman projection and Saw horse formulae, Fischer and Flying wedge formulae and inter conversion of Projection formulae .

UNIT-V: ALKANES, CYCLOALKANES AND ALKYL HALIDES

Mechanism of free radical halogenation of alkanes, reactivity and selectivity.

Cycloalkanes:nomenclature, methods of preparations, chemical reactions. Bayer's strain theory and its limitations, ring strain in cyclopropane and cyclobutanes.

Alkyl Halides:Nomenclature and classes of alkyl halides, methods of formation, chemical reactions mechanisms of nucleophilic substitution reaction of alkyl halides, SN2 and SN1 reactions, with energy profile diagrams. Polyhalogen compounds: chloroform, carbon tetrachloride.

SUGGESTED READINGS:

1. Organic chemistry Vol I by M.Mukherji, P.singh and P.kapoor, New age international (p) limited
2. Organic chemistry Vol I by M.k Jain and S.C Sharma, Shobanlal \$ Co educational publisher
3. Organic chemistry Vol I by Dr.Jagdambasingh and L.D.S Yadav, Pragatiprakash
4. Organic chemistry by Morrison & Boyd, Pearson
5. Organic chemistry Vol I by Singh, Pardasani and Pathak, Ramesh book depot (hindi&english)
6. Organic chemistry Vol I by Ameta, Sharma, Punjabi and Sharma, Himanshu publication
7. Understanding organic chemistry by Brown, Foote, Iverson, Anslyn, Cenage learning

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BSCH121-LABORATORY COURSE-I

1. INORGANIC CHEMISTRY

a. Volumetric Analysis

I. Preparation of standard solutions.

II. Dilution of solutions.

III. Redox titrations

1. Determination of the strength of oxalic acid & ferrous sulphate by titrating it against the KMnO_4 (Concept of self-Indicator).
2. Determine the strength of the ferrous ammonium sulphate by titrating it against $\text{K}_2\text{Cr}_2\text{O}_7$ using external indicator & internal indicator.
3. Estimation of the potassium dichromate iodometrically.
4. Estimation of copper iodometrically.

2. ORGANIC CHEMISTRY

b. Laboratory Techniques: TLC/paper chromatography- separation of dyes.

c. Stereochemistry: study through models.

1. Conformational Analysis of ethane, n-butane and cyclohexane.
2. Geometrical isomerism and their E/Z nomenclature.
3. Optical isomerism and assigning R/S configuration.

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B.Sc- IIND SEMESTER CHEMISTRY

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| BSCH212 | ORGANIC CHEMISTRY-II | 3 | 3 hrs. | 20 | 80 | 100 |
| BSCH221 | LABORATORY COURSE-II | 6 | 3 hrs. | 20 | 80 | 100 |
| Grand Total | | | | | | 300 |

BSCH211- PHYSICAL CHEMISTRY-I

UNIT-I: MATHEMATICAL CONCEPTS

Logarithmic relations, curves stretching, linear graphs and calculation of slopes, Differentiation of functions like ax , ex , xn , $\sin x$, $\log x$; maxima and minima. Integration of some useful /relevant functions permutations, combinations and probability.

UNIT-II: GASEOUS STATES

Postulates of kinetic theory of gases, deviation from ideal behaviour, Van-der Waals equation of State.

Critical phenomenon: PV isotherms of ideal gases, continuity of states, the isotherms of van der Waals equations, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of states.

Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter.

UNIT-III: LIQUID STATE

Characteristics of Liquid state: Vapour pressure, vapour pressure and boiling point, measurement of vapour pressure (static method and gas saturation method), viscosity, measurement of viscosity, specific viscosity (Ostwald's viscometer and Stokes falling sphere method), effect of temperature on viscosity and viscosity of mixtures, Surface tension, phenomenon of capillary action, measurement of surface tension (drop weight and drop number method), effect of temperature and surface tension of mixtures.

Liquid crystals: Difference between liquid crystal, solid and liquid. Classification and structure of nematic, smectic and cholesteric phases, swarm theory of liquid crystal.

UNIT-IV: SOLID STATE

Introduction and classification of solids, definition of space lattice, unit cell, laws of crystallography (i) law of constancy of interfacial angles, (ii) law of rational indices, (iii) law of symmetry.

Symmetry elements in crystals. Weiss and Miller indices, lattice planes in cubic system, interplanar distances for cubic system. Density of cubic crystal.

X-ray diffraction by crystals, derivation of Bragg's equation, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, KCl and CsCl.

Defects in crystals: point and line defects in crystals.

UNIT-V: COLLOIDAL STATE

Colloidal: Definition, classification, preparation.

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Hydrophobic colloidal system: electrical properties (origin of charge, electrical double layer, DLVO theory of stability of hydrophobic colloid, coagulation of colloidal sols), Electrokinetic properties (electrophoresis, electro-osmosis).

Micelle: Micelle formation, shapes & structure of micelle, micellar aggregation number.

Emulsion: definition, types: macroemulsion, microemulsion, formation of emulsions, factors determining stability, inversion of emulsions, theories of emulsion.

Gels: preparation of gels, elastic & non elastic gels.

SUGGESTED READINGS:

1. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
2. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
3. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
4. Physical Chemistry Through Problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
5. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Nagin Chand & Co.
6. Physical Chemistry, Bahadur Tuli, S. Chand & Co. (P) Ltd.
7. Physical Chemistry, Vol. I & II, S. Pahari, New Central Book Agency (P) Ltd.
8. Physical Chemistry, Vol. I, II & III, K.L. Kapoor, MacMillan
9. Physical Chemistry, S. Ameta, Himanshu Publication (Hindi)
10. Physical Chemistry, P.D. Sharma, Ramesh Book Depot.

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BSCH212-ORGANIC CHEMISTRY-II

UNIT-I: ALKENES

Mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regio-selectivity in alcohol dehydration, the Saytzeff rule, Hoffmann elimination, mechanisms involved in hydrogenation, hydroboration-oxidation oxymercuration-reduction, Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO_4 , Substitution at the allylic and vinylic positions of alkenes, industrial applications of ethylene and propene.

UNIT-II: CYCLOALKENES, DIENES AND ALKYNES

Dienes: Nomenclature and classification of dienes: isolated conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions-1,2 and 1,4 additions, Diels Alder reaction.

Alkynes: Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation and polymerization

UNIT-III: ARENES AND AROMATICITY

Nomenclature of benzene derivatives, structure of benzene and its MO picture. Aromaticity the Huckel rule. Aromatic electrophilic substitution general pattern of the mechanism, role of π complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams, activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. Mechanism of nucleophilic aromatic substitution (elimination-addition, addition-elimination). Method of formation of aryl halides, nuclear and side chain reaction. Methods of formation and chemical reactions of biphenyl.

Howarth synthesis of naphthalene, phenanthrene & anthracene and their chemical reactions, structure of naphthalene.

UNIT-IV: ALCOHOL

Monohydric Alcohols: Classification and nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, Acidic nature, Reactions of alcohols.

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.

Trihydric alcohols: Nomenclature and methods of formation, chemical reactions of glycerol.

UNIT-V: PHENOL

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohol and phenol, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement. Gattermann synthesis. Hauben Hoesch reaction. Lederer-Manasse reaction and Reimer-Tiemann reaction.

SUGGESTED READINGS:

1. Organic chemistry Vol I by M. Mukherji, P. Singh and P. Kapoor, New age international (p) limited
2. Organic chemistry Vol I by M.K Jain and S.C Sharma, Shobanlal & Co educational publisher
3. Organic chemistry Vol I by Dr. Jagdambasingh and L.D.S Yadav, Pragati Prakash
4. Organic chemistry by Morrison & Boyd, Pearson
5. Organic chemistry Vol I by Singh, Pardasani and Pathak, Ramesh book depot (hindi & english)
6. Organic chemistry Vol I by Ameta, Sharma, Punjabi and Sharma, Himanshu publication

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BSCH221- LABORATORY COURSE-II

A. Organic Chemistry

1. Organic preparations:

- a. Iodoform from ethanol and acetone
- b. Urea oxalate
- c. Urea nitrate

B. Physical Chemistry

2. Surface Tension :

- a. To determine the surface tension of given liquid by stalagmometer (Acetone, Ethyl alcohol, Ethyl acetate).
- b. To determine the composition of a binary mixture by measurement of surface tension.

3. Viscosity:

- a. To determine the viscosity of the given organic liquid by Ostwald viscometer (Acetone, Ethyl alcohol, Ethyl acetate).
- b. To determine the composition of a binary mixture by Viscosity measurement.
- c. To determine the viscosity and viscosity index of given lubricating oil using Redwood viscometer.

C. Study of the unit cells and crystal structure through models.

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B.Sc- IIIRD SEMESTER

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|-------------|------------------------|------|--------|-----|-----|-------|
| BSCH311 | INORGANIC CHEMISTRY-II | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH312 | PHYSICAL CHEMISTRY-II | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH321 | LABORATORY COURSE-III | 6 | 3 hrs. | 20 | 80 | 100 |
| GRAND TOTAL | | | | | | 300 |

BSCH311: INORGANIC CHEMISTRY-II

UNIT-I: COVALENT BONDING

Definition, factors favouring formation of covalent bond, covalency and maximum covalency, failure of octet rule: Sidgwick rule, Sugden's concept of singlet bond, Lewis dot structure.

Valence shell electron pair repulsion (VSEPR) theory and shapes of simple molecules and ions containing lone pair and bonded pair of electrons.

Valence Bond Theory: Heitler and London theory for H₂ molecule, Pauling and Slater –Overlapping of Orbitals, σ and π bond approach.

Hybridisation: Determination, rules and types of hybridization, equivalent & non-equivalent hybrid orbitals.

Concept of Resonance & resonance energy: definition, condition and characteristics.

UNIT-II: MO THEORY

LCAO approach, bonding and antibonding molecular orbitals molecular orbital diagrams of homodiatom & heterodiatom molecules N₂, O₂, C₂, B₂, F₂, CO, NO, HF & ICl and their ions (idea of s-p mixing and orbital interactions to be given).

Dipole moment comparison of the dipole moment of common molecules, applications of dipole moment.

Percentage ionic character in covalent bond: calculation by using electronegativity & dipole moment concept.

UNIT-III: p-block elements (13th, 14th, 15th GROUP)

Electronic configuration, relative stability of different oxidation states, inert pair effect and anomalous behaviour of first member of each group & oxides and hydrides-reactivity and nature and hydrolysis of oxides.

Preparation, structure and nature of oxyacids of B, N and P.

UNIT-IV: p block elements (16th, 17th GROUP)

Electronic configuration, relative stability of different oxidation states, inert pair effect and anomalous behaviour of first member of each group. Oxide- reactivity and nature. Oxy acids of S - sulphuric acid, sulphurous acid and relative nature of oxyacids of halogen.

Interhalogen compounds –preparation, structure and properties (AB, AB₃, AB₅, AB₇).

UNIT-V: NOBEL GASES

Discovery of Nobel gases their separation.

Preparation and Properties and geometries of XeF₂, XeF₄, XeF₆, XeOF₄, XeO₂F₂. Clathrates formed by Nobel gases.

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SUGGESTED READINGS:

1. Principles of Inorganic Chemistry by B.R.Puri, L.R.Sharma and Kalia.
2. Advanced Inorganic Chemistry, vol I, by Satyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan.
3. Selected Topics in Inorganic Chemistry by Wahid.U.Malik, G.D.Tuli, R.D.Madan.
4. Fundamental concepts of Inorganic Chemistry, vol.I, by Asim.K.Das.
5. Inorganic Chemistry, vol I by Ameta, Daga, Sharma and Mehta. , Himanshu publication (Hindi)
6. Inorganic Chemistry, vol I by Ojha ,Chaturvedi, Ramesh book depot (Hindi & English)

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BSCH312: PHYSICAL CHEMISTRY-II

UNIT I : CHEMICAL KINETICS-I

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction: concentration, temperature, pressure, solvent, light, catalyst & concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero order, first order & second order, half life and mean life. Determination of the order of reaction differential method, method of integration, method of half life period and isolation method.

UNIT-II: CHEMICAL KINETICS-II

Experimental methods of chemical kinetics: Conductometric, potentiometric, optical methods, polarimetry and spectrophotometry. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model & transition state theory.

UNIT-III: PHASE EQUILIBRIUM-I

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system - water, CO₂ and sulphur system.

Phase equilibria of two component system: solid -liquid equilibria, simple eutectic -Bi-Cd, Pb-Ag systems, desilverisation of lead.

UNIT IV: PHASE EQUILIBRIUM-II

Solid solutions: Compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl- H₂O), (FeCl₃-H₂O) and CuSO₄-H₂O system. Freezing mixtures, acetone dry ice.

Nernst distribution law: (i) distributing substance associated in one phase (ii) distributing substance dissociate in one phase (iii) solute combines with one of the solvent Application of distribution law (solvent extraction).

UNIT-V: LIQUID-LIQUID MIXTURES

Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system azeotropes: HCl H₂O and ethanol - water systems.

Partially miscible liquids -Phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature. Immiscible liquids, steam distillation.

SUGGESTED READINGS:

1. Physical Chemistry, G.M. Barrow, International Student Edition, McGrawHill.
2. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
3. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
4. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
5. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Nagin chand & Co.
6. Physical Chemistry, Bahland Tuli, S. Chand & Co. (P) Ltd.
7. Physical Chemistry, Vol. I & II, S. Pahari, New Central Book Agency (P) Ltd.
8. Physical Chemistry, Vol. I, II & III, K.L. Kapoor, MacMillan
9. Physical Chemistry, S. Ameta, Himanshu Publication (Hindi)
10. Physical Chemistry, P.D. Sharma, Ramesh Book Depot

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BSCH321: LABORATORY COURSE IV

A. INORGANIC CHEMISTRY

Qualitative Analysis

Qualitative estimation of the inorganic mixture for five radicals including interfering acid radicals, their combinations and insoluble oxides, sulphates and halides.

B. PHYSICAL CHEMISTRY

a) Chemical Kinetics

- i. To determine the order of acid hydrolysis of ester and its rate constant using integrated rate law method and graphical method.
- ii. Determine the rate constant and order of base hydrolysis of ester.
- iii. To study the kinetics of acetone iodine reaction and determine the order with respect to
 1. Iodine
 2. Acetone

b) Distribution Law

- i. To determine the distribution coefficient of I_2 between CCl_4 and water.
- ii. To study the distribution of benzoic acid between benzene and water and hence show that benzoic acid dimerises in benzene.

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B.Sc- IVTH SEMESTER

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| BSCH411 | INORGANIC CHEMISTRY-III | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH412 | ORGANIC CHEMISTRY-III | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH421 | LABORATORY COURSE-IV | 6 | 3 hrs. | 20 | 80 | 100 |
| GRAND TOTAL | | | | | | 300 |

BSCH411: INORGANIC CHEMISTRY-III

UNIT-I: QUANTITATIVE ANALYSIS AND ERRORS IN ANALYSIS

Gravimetric Analysis: Precipitation: Concept of common ion effect and solubility product and conditions of precipitation (no mathematical treatment), Co-precipitation and Post precipitation.

Volumetric analysis: basic requirement of titration reaction, standard solutions, primary standards, expressing concentration of standard solution, cautions in volumetric analysis and correction of unavoidable errors.

Errors in chemical analysis: Types of error and their minimization; Accuracy, Precision, calculation of absolute and relative error and Standard Deviation.

UNIT-II: CHEMISTRY OF TRANSITION METALS

General Characteristics and Periodicity in properties with emphasis on their electronic configuration and variable oxidation states of 3d, 4d and 5d series elements. Spectral properties, catalytic properties and complex formation tendency in 3d series elements, magnetic properties: types of magnetic behaviours, magnetic moment: spin only formula, magnetic susceptibility and method of determination of magnetic susceptibility (Gauy's and Faraday's method).

UNIT-III: CHEMISTRY OF INNER-TRANSITION METALS

Lanthanides: Electronic structure, oxidation state, atomic and ionic radii, lanthanide contraction and its consequences, colors or spectral and magnetic properties.

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

UNIT-IV: CHEMISTRY OF REDOX REACTION

Oxidation and Reduction, application of electrochemical series – oxidising and reducing property of substances in aqueous solution, reactivity of metals & non-metals, spontaneity of redox reactions & disproportionation reaction. Diagrammatic representation of potential data: Latimer, Frost & Ellingham diagrams and their use in extraction of metals.

UNIT-V: CONCEPTS OF ACIDS AND BASES

Arrhenius, Bronsted-Lowry, Lewis and Usanovich concept. Acid base titrations, Redox titrations and theory of indicators.

Non aqueous solvents: Physical properties of solvent, types of solvents and their general characteristics. Reactions in non aqueous solvents with reference to liquid NH₃ and SO₂.

SUGGESTED READINGS:

1. Principles of Inorganic Chemistry by B.R.Puri, L.R.Sharma and Kalia.
2. Advanced Inorganic Chemistry, vol I, by Satyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan.
3. Selected Topics in Inorganic Chemistry by Wahid.U.Malik, G.D.Tuli, R.D.Madan.
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BSCH412: ORGANIC PAPER III

UNIT-I: SPECTROSCOPY I

Ultraviolet (UV) absorption spectroscopy: Absorption laws (Beer-Lambert law), 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.

Infrared (IR) absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands of various functional groups, fingerprint region, functional groups and interpretation of IR spectra of simple organic compounds.

UNIT-II: SPECTROSCOPY II

NMR: PROTON MAGNETIC RESONANCE SPECTROSCOPY

Nuclear shielding and deshielding, chemical shift, spin-spin coupling, coupling constant, area of signals. Interpretation of PMR spectra of ethyl bromide, acetaldehyde, 1,1,2-tribromoethane, ethylacetate, toluene and acetophenone.

Problem pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR.

UNIT-III: CHEMISTRY OF CARBONYL COMPOUNDS

Nomenclature and structure and physical properties 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 and synthesis of ketones from nitriles and from carboxylic acids. Enolisation of carbonyl compounds, protecting groups.

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, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction.

MPV, Clemmensen, Wolff-Kishner, LiAlH_4 and NaBH_4 reduction.

UNIT-IV: CHEMISTRY OF CARBOXYLIC ACIDS

Nomenclature, structure and bonding. Physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids, decarboxylation, esterification and hydrolysis of esters (acidic and basic). Methods of formation and chemical reactions of haloacids and hydroxyacids and action of heat on them.

Reactive methylene compounds: Malonic ester and acetoacetic ester preparation and synthetic applications.

UNIT-V: FAT, OILS, DETERGENT AND POLYMERS

Common fatty acids, hydrogenation of unsaturated oils, saponification value, iodine value, cleaning action of soaps and detergents.

Polymer: Addition or chain growth polymerization, free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization. Condensation or step growth polymerizations. Concept of dendrimers. Polyesters, polyamides, phenol-formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes.

SUGGESTED READINGS:

1. Organic Spectroscopy, YR Sharma, S Chand Publication.
2. Organic Chemistry, Solomon and Fryhle, Wiley
3. Organic Chemistry, Loudon, Roberts and Company Publishers.
4. Organic chemistry, M. Mukherji, P. Singh and P. Kapoor, New age international (p) limited
5. Organic chemistry Vol II & III by M.K Jain and S.C Sharma, Shobanlal & Co educational publisher

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6. Organic chemistry Vol II & III, Dr.Jagdamba Singh and L.D.S Yadav, Pragatiprakashan
7. Organic chemistry by Morrison & Boyd, Pearson
8. Organic chemistry Vol II& III by Singh, Pardasani and Pathak, Ramesh book depot (hindi&english)
9. Organic chemistry Vol II& III by Ameta, Sharma, Punjabi and Sharma, Himanshu publication
10. Understanding Organic Chemistry by Brown, Foote, Iverson &Anslyn, Cenage learning

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BSCH421: LABORATORY COURSE- IV

A. Inorganic chemistry

A. Gravimetric estimation

- i. Barium as barium sulphate.
- ii. Zinc as zinc oxide
- iii. Copper as copper oxide

B. Organic Chemistry

- A. Complete identifications of organic compounds including element detection, melting/boiling point and functional group. **(two compounds may be given)**

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B.Sc - VTH SEMESTER

| CODE | DESCRIPTION | PD/W | EXAM | CIA | ESE | TOTAL |
|-------------|------------------------|------|--------|-----|-----|-------|
| BSCH511 | ORGANIC CHEMISTRY-IV | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH512 | PHYSICAL CHEMISTRY-III | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH521 | LABORATORY COURSE-V | 6 | 3 hrs. | 20 | 80 | 100 |
| GRAND TOTAL | | | | | | 300 |

BSCH511: ORGANIC CHEMISTRY-IV

UNIT-I: HETEROCYCLIC COMPOUNDS

Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Method of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution.

Mechanism of nucleophilic substitution reaction in pyridine. Basicity and acidity of nitrogen heterocycles.

Condensed heterocycles: Preparation of Indole, Quinoline, Isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-napieralski synthesis and chemical reactions.

UNIT-II: CHEMISTRY OF CARBOHYDRATES

Classification and nomenclature, oxidation and reduction reactions of carbohydrates. Mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldose. Configuration of monosaccharides. Erythro and threodiastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Cyclic structure D glucose. Mechanism of mutarotation. Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides: starch and cellulose without involving structure determination.

UNIT-III: CHEMISTRY OF NITROGEN CONTAINING COMPOUNDS

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.

Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Structural features affecting basic nature of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, Nitriles, reductive amination of aldehydic and ketonic compounds). Gabriel – phthalimide reaction. Hoffmann bromamide reaction. Reaction of amines (alkylation, reaction with acid chlorides, nitrous acid, phenyl isocyanate). Synthetic transformations of aryl diazonium salts, azo coupling. Amine salts as phase – transfer catalysts.

UNIT-IV: ETHERS AND EPOXIDES, ORGANO MAGNESIUM AND ORGANOSULFUR COMPOUNDS

Nomenclature of ethers and methods of their formation, physical properties. Chemical reactions – cleavage and autoxidation, Ziesel's method for methoxy group estimation

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxide.

Organosulfur compounds; nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanide and mode of action of sulphur drugs.

Grignard reagent: preparation and reactions

UNIT-V: CHEMISTRY OF BIOMOLECULE: AMINO ACIDS AND PEPTIDES

Classification, structure and stereochemistry of amino acids, acid-base behaviour, isoelectric point, preparation and reactions of amino acids. Structure and nomenclature of peptides. group

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Determination of peptide structure(hydrolysis, sequential degradation and specific cleavage).
Classical and solid phase peptide synthesis. Electrophoresis

SUGGESTED READINGS:

1. Organic Chemistry, Solomon and Fryhle, Wiley
2. Organic Chemistry, Loudon, Roberts and Company Publishers.
3. Organic Chemistry VOL. II, I.L. Finar, Pearson.
4. Organic chemistry, M. Mukherji, P. Singh and P. Kapoor, New age international (p) limited
5. Organic chemistry Vol II & III by M.K Jain and S.C Sharma, Shobanlal & Co educational publisher
6. Organic chemistry Vol II & III, Dr. Jagdamba Singh and L.D.S Yadav, Pragati Prakashan
7. Organic chemistry by Morrison & Boyd, Pearson
8. Organic chemistry Vol II & III by Singh, Pardasani and Pathak, Ramesh book depot (Hindi & English)
9. Organic chemistry Vol II & III by Ameta, Sharma, Punjabi and Sharma, Himanshu publication
10. Understanding Organic Chemistry by Brown, Foote, Iverson & Anslyn, Cengage learning

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BSCH512: PHYSICAL CHEMISTRY-III

UNIT-I: THERMODYNAMICS -I

Definition of some basic thermodynamic terms, State functions

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity: heat capacities at constant volume, constant pressure and their relationship. Joule's law, Joule Thomson coefficient and inversion temperature. Calculation of W , q , dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Kirchoff's equation.

UNIT-II: THERMODYNAMICS-II

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

Concept of entropy: Entropy as a state function, entropy as a function of V & T , entropy as a function of pressure & temperature, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third Law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data,

UNIT-III: THERMODYNAMICS-III

Criteria for reversible and irreversible process Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, Gibbs-Helmholtz equation, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of Gibbs free energy with P , V and T .

Chemical Equilibrium: Equilibrium constant and free energy. Reaction isotherm and reaction isochor - Clapeyron equation and Clausius - Clapeyron equation and its applications.

UNIT-IV: ELECTROCHEMISTRY -I

Electrical transport: Conduction in metals and in electrolyte solutions, Faradays law of electrolysis, specific conductance and equivalent conductance, Ionic strength, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlraush's law, 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.

UNIT-V: ELECTROCHEMISTRY-II

Types of reversible electrodes: gas metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance. 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. Definition of pH , determination of pH using hydrogen, quinhydrone and glass electrode, potentiometric titration, Concentration cell with and without transference.

SUGGESTED READINGS:

1. Physical Chemistry, G.M. Barrow, International Student Edition, McGrawHill.
2. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
3. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
4. Physical Chemistry Through Problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.

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5. Principles of Physical Chemistry, B.R.Puri, L.R.Sharma and M.S. Pathania, Shobhan Lal Naginchand & Co.
6. Physical Chemistry, Bahadur Tuli, S.Chand & Co. (P) Ltd.
7. Physical Chemistry, Vol. I & II, S.Pahari, New Central Book Agency (P) Ltd.
8. Physical Chemistry, Vol. I, II & III, K.L. Kapoor, MacMillan
9. Physical Chemistry, S. Ameta, Himanshu Publication (Hindi)
10. Physical Chemistry, P.D. Sharma, Ramesh Book Depot

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BSCH521: LABORATORY COURSE-V

A. PHYSICAL CHEMISTRY

a. pH metry

- i. To measure the pH of the given solution using pH meter.
- ii. Determine the strength of given strong/weak acid by titrating it against the strong base pH metrically.

b. Conductometry

- i. To determine the specific conductivity, molar and equivalent conductivity of the given solution.
- ii. Determine the strength of given strong/weak acid by titrating it against the strong base conductometrically.

B. ORGANIC CHEMISTRY

- a. Systematic analysis of two components Organic Mixture using water, sodium bicarbonate and NaOH.

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B.Sc - VITH SEMESTER

| CODE | DESCRIPTION | PD/W | EXAM | CIA | ESE | TOTAL |
|-------------|------------------------|------|--------|-----|-----|-------|
| BSCH611 | INORGANIC CHEMISTRY-IV | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH612 | PHYSICAL CHEMISTRY-IV | 45 | 3 hrs. | 20 | 80 | 100 |
| BSCH621 | LABORATORY COURSE-VI | 6 | 3 hrs. | 20 | 80 | 100 |
| GRAND TOTAL | | | | | | 300 |

BSCH611: INORGANIC CHEMISTRY-IV

UNIT-I: COORDINATION CHEMISTRY

Werner's coordination theory and its experimental verification, different types of ligands including chelates and pi acceptor ligands, nomenclature and formulation of coordination compounds, effective atomic number, stereoisomerism in complexes of coordination number 4 and 6.

Complexometric titrations and theory of metallochrome indicators.

UNIT-II: METAL LIGAND BONDING IN 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). Application of crystal field theory, Jahn Teller effect.

UNIT-III: STABILITY OF TRANSITION 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, experimental determination of stability constant and composition of complex (Job's Method and Bjerrum's Method).

UNIT-IV: HARD AND SOFT ACID & BASES CONCEPT (HSAB)

Classification of acid and base as hard and soft, Pearson's HSAB concept and its applications. Symbiosis, theoretical basis of hardness and softness, electronegativity, hardness and softness and limitation of HSAB principle.

Bioinorganic Chemistry

Essential and trace elements in biological processes, Biological role of alkali (Na, K, Li) and alkaline earth (Mg, Ca) metals.

UNIT-V: 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).

SUGGESTED READINGS:

1. Principles of Inorganic Chemistry by B.R.Puri, L.R.Sharma and Kalia.
2. Advanced Inorganic Chemistry, vol II, by Satyaprakash, G.D.Tuli, S.K.Basu and R.D.Madan.
3. Selected Topics in Inorganic Chemistry by Wahid.U.Malik, G.D.Tuli, R.D.Madan.
4. Fundamental concepts of Inorganic Chemistry, vol.I, by Asim.K.Das.
5. Inorganic Chemistry, vol III by Ameta, Daga, Sharma and Mehta. , Himanshu publication (Hindi)
6. Inorganic Chemistry, vol III by Ojha ,Chaturvedi, Ramesh book depot (Hindi & English)

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BSCH612: PHYSICAL CHEMISTRY-IV

UNIT-I: QUANTUM MECHANICS

Black-body radiation, Planck's radiation law, photoelectric effect, Bohr's model of hydrogen atom and its defects. Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle. Operators Schrodinger wave equation and its importance physical interpretation of the wave function, postulates of quantum mechanics. particle in a one dimensional box & its importance .

UNIT-II: SPECTROSCOPY-I

Introduction : electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

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

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups

UNIT-III: SPECTROSCOPY-III

Raman spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of Diatomic molecules and selection rules.

Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals. Qualitative description of selection rules and Frank-Condon principle. Qualitative description of σ , π and n MO, their energy levels and the respective transitions.

UNIT-IV: PHOTOCHEMISTRY

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

UNIT-V: PHYSICAL PROPERTIES AND MOLECULAR STRUCTURE

Optical activity, polarization - (Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment. Measurement of dipole moment- temperature and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetics.

Suggested Readings:

1. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
2. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
3. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
4. Physical Chemistry Through Problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
5. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobhan Lal Nagin Chand & Co.
6. Physical Chemistry, Bahadur Tuli, S. Chand & Co. (P) Ltd.
7. Physical Chemistry, Vol. I & II, S. Pahari, New Central Book Agency (P) Ltd.
8. Physical Chemistry, Vol. I, II & III, K.L. Kapoor, MacMillan
9. Physical Chemistry, S. Ameta, Himanshu Publication (Hindi)
10. Physical Chemistry, P.D. Sharma, Ramesh Book Depot

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BSCH621: LABORATORY COURSE-VI

A. Inorganic

a. Inorganic preparations

- i. FAS
- ii. Potash alum
- iii. Microcosmic salt
- iv. Tetraamminecoppersulphate
- v. Hexathiourealead(II) nitrate
- vi. Cis& trans potassium diaquodioxalatochromate(III)

B. Water & Soil Analysis

- I. Determine the permanent, temporary and total hardness of the given water sample using complexometric titration method.
- II. Determine the permanent, temporary and total hardness of the given water sample using Clark's method.
- III. Determine the COD of the given water sample.
- IV. Determine the available carbon in the given soil sample.

C. Physical

- I. To verify the Lambert-Beer's law and determine the concentration of given solution (CoCl_2 & NiSO_4).
- II. Jobs method for composition of Fe(III) and SCN^- complex.