Mata Gujri Mahila Mahavidyalya (Autonomous) Jabalpur

Syllabus

Class - B.Sc. II Year

Subject- Chemistry

Paper -I

Physical Chemistry

Unit I

(A) Thermodynamics:

Basic concepts of thermodynamics, First law, Second law of Thermodynamics: Need for the law, Different statements of the law, Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature, concept of Entropy: entropy as a state function, entropy as a function of P & T and T & V, entropy change in physical change. Clausius inequality. Entropy as criteria of spontancity 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 Gibbs and Helmholtz functions, Gibbs function (G) and Helmholtz function (H) as a thermodynamic quantities. A and G as a criteria for thermodynamic equilibrium and spontaneity their advantage over entropy change. Clausius Clayperon Equation.

(B) Thermochemistry

Standard state, standard enthalpy of formation: Hess's Law of heat summation and its application. Enthalpy of neutralization.

Unit II

(A) Phase equilibrium

Statement and the meaning of terms: phase, component and the degree of freedom, thermodynamic derivation of the Gibbs phase rule, one component system: water, CO_2 and S system, two component system: soild-liquid equilibrium, simple eutectic system: Bi-Cd; Pb-Ag system, Desilverisation of lead.

(B) Solid solution

Systems in which compound formation with congruent melting point (Zn-Mg) and incongruent melting point. ($NaCl$-H_2O) and ($CuSO_4$-H_2O) system, Freezing Mixtures: acetone-dry ice.

(C) Liquid Liquid mixtures

Ideal liquid mixtures. Raoult's and Henry law, Non-ideal system, azeotrops: HCl-H_2O and ethanol water system.

(D) Partial miscible liquids

Phenol-water, trimethylamine- water and nicotine-water system, Lower and upper consolute temperature, Immiscible Liquids steam distillation. Nernst distribution law: thermodynamic derivation, applications.

Unit III

Electrochemistry- I

Electrical transport, conduction in metals and in electrolyte solutions, specific and equivalent conductivity, measurement of equivalent conductance, effect of dilution on conductivity, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes, Ostwald dilution law, Theory of Strong electrolytes, DHO theory and equation, transport numbers, determination of transport numbers by Hittorf method and moving boundary method.

Unit IV

Electrochemistry- II

Types of reversible electodes: Gas- metal ion, metal-metal-ion, metal- insoluble salt anion and redox electrodes. Electrodes reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, electrochemical series and its significance.

Electolytic and Galvanic cells, reversible and irreversible cell, conventional representation of electochemical cells.

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valancy of ions, solubility product and activity coefficient, potentiometric titration, Definition of pH and pK, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods.

Buffers: mechanism of buffer action, Henderson- Hazal equation, hydrolysis of salts.

Processes at electrodes, rate of charge transfer, current density, polarography, amperomerty, ion selective electrodes and their uses.

Unit V

(A) Surface Chemistry

Adsorption, adsorption and absorption, types of adsorption, adsorption of gases and liquids in solid adsorbent. Freundlich and Langmur adsorption isotherms, surface area and determination of surface area.

(B) Catalysis

characteristics of catalyzed reactions, classification of catalysis, application of catalysts, miscellaneous examples.

Mata Gujri Mahila Mahavidyalya (Autonomous) Jabalpur

Syllabus

Class - B.Sc. II Year

Subject- Chemistry

Paper -II

Inorganic Chemistry

Unit 1

Chemistry of Elements of First Transition Series

Characteristic properties of d-block elements, Properties of the elements of the first transition series, their binary compounds such a Carbides, Oxides and Sulphides. Complexes illustrating relative stability of their oxidation states, co-ordination number and geometry.

Unit II

Chemistry of Elements of Second and Third Transition Series

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

Unit III

(A) Co-ordination Compunds

Werner's co-odination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of co-ordination compounds, isomerism in co-ordination compounds, valence bond theory of transition metal complexes.

(B) Oxidation and Reduction

Use of redox potential data: analysis of redox cycle, redox stability in water: frost, latimer and Pourbaix diagrams. Principles involved in the extraction of elements.

Unit IV

General Chemistry of F- Block Elements

Lanthanides and Actinide - Electronic structure, ionic radii, complex formation, separation, oxidation states, magnetic and spectral properties, lanthanide contraction.

Unit V

(A) Acids and Bases

Arrhenius, Bronsted- Lowry, Lux-Flood, solvent system and Lewis concepts of acids and bases.

(B) Non- aqueous Solvents

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

Mata Gujri Mahila Mahavidyalya (Autonomous) Jabalpur

Syllabus

Class - B.Sc. II Year

Subject- Chemistry

Paper -III

Organic Chemistry

Unit 1

Electromagnetic Spectrum: Absorption spectra

Ultraviolet (UV) absorption spectroscopy- absorption laws (Beer Lambert Law), Molar absorptivity, Presentation and analysis of UV spectra, Types of electronic transitions, Effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hyposochromic, hyperchromic and hyprochromic shifts. UV spectra of conjugated enes and enones.

Infra red (IR) absorption spectroscopy- Molecular vibrations, Hookes law, selection rules, intensity and position of IR bands, Measurement of IR spectrum, finger print region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

Unit II

(A) Alcohols

Classification and nomenclature, Monohydric alcohols-Nomenclature, methods of formation, reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, acid nature and reactions of alcohols.

Dihydric alcohols-nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage ($Pb(OAc)_4$ and HIO_4) and pinacol-pinacolone rearrangement, Trihydric alcohols- Nomenclature, methods of formation, Chemical reactions of glycerols.

(B) Phenols

Nomenclature, structure and bonding, Preparations of phenols, physical properties and acidic character, comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ions. Reactions of phenols- Electrophillic aromatic substitution, acylation and carboxylation, Mechanism of Fries rearrangement, Claisen

rearrangement, Gatermann synthesis, Hauben-Hoesche reaction, Lederer Manasse reaction and Reimer Teiman reaction.

Unit III

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, synthesis of aldehydes and ketones using 1,3 dithianes, synthesis of ketones from nitrilles and from carboxylic acids. Physical properties, Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig and Mannich reaction. Use of acetals as protecting groups, Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizaro reaction, MPV, Clemmensen, Wolf Kischner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones. An introduction to alfa, beta unsaturated aldehydes and ketones.

Unit IV

(A) Carboxylic Acids

Nomenclature, structure and bonding, physical properties and acidity of carboxylic acids, Effects of substituents on acid strength. Preparation of carboxylic acids and reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids, hydroxyl acids, Malic, Tartaric and citric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids-Methods of formation and effect of heat and dehydrating agents.

(B) Ether

Nomenclature of ethers and methods of their formation. Physical properties and chemical reactions. Cleavage and auto oxidation, Ziesels method.

Unit V

Organic compounds of Nitrogen

Preparation of nitro alkanes and nitro- arene. Chemical reactions of nitro-alkanes. Mechanism of nucleophilic substitution in nitro-arenes and their reductions in neutral acidic and alkaline media.

Halonitroarenes; reactivity, structure and nomenclature of amines, physical properties, stereochemistry of animes, separation of mixture of primary, secondary and tertiary amines. Structural features, effecting basicity of amines. Amine salts as phase transfer catalyst. Preparation of alkyl and aryl amine (reduction of nitro compounds, nitilles Reductive animation of aldehydic and ketonic compounds. Gabriel-Phthalamide reaction Hoffmann-Bromanide reaction. Reactions of Amines. Electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acids. Synthetic transformations of aryl diazonium salts, Azo coupling.

Mata Gujri Mahila Mahavidyalya (Autonomous) Jabalpur

Syllabus

Class - B.Sc. III Year

Subject- Chemistry

Paper -I

Physical Chemistry

Unit 1

(A) Elementary Quantum Mechanics

Black-body radiation. Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects. Compton effect.

de-Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation. Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function. Postulates of quantum mechanics, particle in a one-dimensional box.

(B) Molecular orbital theory

Basic ideas-criteria for forming M.O. from A.O., construction of M.O's by LCAO-H_2 ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characters. Hybrid orbitals-sp, sp^2, sp^3: calculation of coefficients of A.O.'s used in these hybrid orbitals.

Introduction to valence bond model of H_2 ion, comparison of M.O. and V.B. models.

Unit II

(A) Spectroscopy

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

(B) 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.

(C) Vibrational Spectrum

Infra-red 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 an harmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Unit III

(A) Raman Spectrum

Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

(B) Electronic Spectrum

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of σ π and n M.O. their energy levels and the respective transition.

(C) UV Spectroscopy

Electronic excitation, elementary idea of instrument used. Application to organic molecules, Woodward-Fieser rule for determining of λ max of enes, polyenes and α, β unsaturated carbonyl compounds.

Unit IV

Photochemistry

Laws of photochemistry: Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of Fluorescence, phosphorescence, non-radioactive processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions, energy transfer processes (simple examples). Photochemical reactions of simple organic compounds Norrish Type I and II reactions.

Unit V

Physical Properties and Molecular Structure

Optical activity, Polarisation (Clausius- Mossotti equation) orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment, temperature method and refractive method, dipole moment and structure of molecules, magnetic properties- paramagnetism, diamagnetism and ferromagnetism.

Mata Gujri Mahila Mahavidyalya (Autonomous) Jabalpur

Syllabus

Class - B.Sc. III Year

Subject- Chemistry

Paper -II

Inorganic Chemistry

Unit 1

(A) Hard and Soft Acids and Bases (HSAB)

Introduction. Classification of hard and soft acid-base, Hard and soft acid-base concept of Pearson, Application of hard-soft acid base theory, Symbosis, acid-base strength and hardness and softness; Theoretical basis of hardness and softness, electronic theory, π-bonding theory and Dragowayland theory, electronegativity and hardness and softness, limitations of hard soft acid-base concept.

(B) Silicones and Phosphazenes

Introduction: silicones-methods of preparation, classification, properties and application (uses). Phosphazenes (Phosphonitrilic chloride)- Methods of preparation and properties: Structure of triphosphazenes. Some other phosphazenes and uses of phosphazenes.

Unit II

(A) Metal Ligand Bonding in Transition Metal Complexes.

Introduction-limitations of valence bond theory, crystal field theory, crystal field splitting of d-orbital, d-orbital splitting and stabilization energy in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters. Applications of crystal field theory and limitations of crystal field theory.

(B) Thermodynamic and Kinetic Aspects of Metal Complexes

Introduction: Thermodynamic aspects of metal complexes, factors affecting thermodynamic stability of complexes, kinetic aspects of metal complexes, stabilization

reactions of square planer complexes and factors affecting the rate of substitution reactions in square planar complexes.

Unit III

Magnetic Properties of Transition Metal Complexes

Introduction: Types of magnetic behavior, diamagnetism. Paramagnetism, Ferromagnetism, Antiferromagnetism, Ferrimagnetisms, Origin and calculation of magnetism. Methods of determining magnetic susceptibility- Guoy, Bhatnagar Mathur, Quincke's, Curie and Nuclear magnetic Resonance method. Magnetic moment: L-S coupling, Determination of ground state term symbol. Correlation of μ_s and μ_{eff} values. Orbital contribution to magnetic moments and application of maganetic moment data for 3d-metal complexes.

Unit IV

Electronic Spectra of Transition Metal Complex

Introduction: Type of electronic transition, Selection rules for d-d transitions; spretoscopic ground states-Notations, Spectroscopic states and spectroscopic ground states in complexes; Spectrochemical series; Orgal energy level diagram-Uses in octahedral and tetrahedral complexes having d^1 to d^9 states: Electronic spectrum of $\{Ti(H_2O)_6]^{+3}$ complex ion.

Complexes with aromatic systems

Synthesis, structure and bonding in metal olefin complexes, alkyne complexes, cyclopenta dienyle complexes, coordinative unsaturation, oxidative addition reactions, insertions reactions, fluxional molecules and their characterization compounds with metal-metal bonds and metal atom clusters.

Unit V

Bio-Inorganic Chemistry

Introduction: Essential and trace elements in biological processes. Biological function of the bio-elements. Availability of bio-metals and bio-non-metals: Metalloporphyrins,

Hemoglobin structure and biological function. Myoglobin-mechanism of oxygen transfer through haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}: Nitrogen fixation.

Metal ion in biological systems and their role in Ion transport across the membranes (molecular mechanism). Oxygen- uptake proteins, cytochromes and ferrodoxins.

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Syllabus

Class - B.Sc. III Year

Subject- Chemistry

Paper -III

Organic Chemistry

Unit 1

Spectroscopy

Nuclear Magnetic Resonance Spectroscopy

Proton Magnetic Resonance (IHNMR) Spectroscopy, Nuclear shielding and de-shielding, chemical shift and molecular structure, spin-spin coupling and coupling constant, region of signals, Explanation of PMR spectra of simple organic molecules like ethyl bromide, ethanol, acetaldehyde, 1,1,2- tribromo ethane, ethylacetate, toluene and acetophenone. Applications of UV, IR and PMR spectroscopy for simple organic compounds.

Unit II

(A) Organo-Metallic compounds

Organomagnesium compounds- Grignard reagent, preparations, structure and chemical reactions.

Organozinc compounds- Preparations and chemical reactions.

Organolithium compounds- Preparations and chemical reactions.

(B) Organo sulphur compounds

Nomenclature, Structural characteristics.

Thio, thio-ether, sulphonic acid, sulphonamide and sulphaguanidine- methods of preparations and chemical reactions.

(C) Preparation and properties of Polymers

Organic polymers – polyethylene, polystyrene, polyvinyl cholide, Teflon, Nylon, Terylene, synthetic and natural rubber.

Unit III

(A) Carbohydrates

Classification and nomenclature-Monosaccharide. mechanism of osazone formation, inter conversion of glucose into fructose, Ascending and descending series in aldose. Configuration of monosaccharide, Stereo isomers of erythro and threo sugars. Conversion of glucose into mannose, Glycosides, determination of the size of the ring of monosaccharides. Ring structure of D(+) glucose, mechanism of mutarotation, structure of ribose and deoxyribose Disaccarides- introductory idea of maltose sucrose, and lactose (Excluding structures) Polysaccharides-introductory idea of starch and cellulose (Excluding structures).

(B) Fat, Oil & Detergents

Natural fat, edible and industrial oil of plant origin.Normal fatty acids, glycosides. Hydrogenation of unsaturated oil, saponification value, iodine value and acid value. Synthetic Detergents: - Alkyl and aryl sulphonate.

Unit IV

Amino Acid, Peptide, Protein and nucleic acid

Classification of amino acids, structure and stereo chemistry, Acid base behavior, Isoelectric point and electrophoresis. Preparations and chemical reactions of alpha amino acids.

Nomenclature and structure of peptide and proteins: Classifications of proteins, determination of peptide structure, end group analysis, selective hydrolysis of petides, peptide synthesis, solid phase peptide synthesis. Denaturation of proteins.

Nucleic Acids: Constitution of nucleic acids, ribonucleoside and ribonucleotide. Double helix structure of DNA.

Unit V

(A) Synthetic dyes

Colour and constitution (electronic concept). Classification of dyes-Methyl orange, Congored, Malachite green, crystal violet, Phenolphthalein, Fluoroscein, Alizarine and indigo- Chemical study and synthesis.

(B) Pericyclic Reactions

Classification and examples, Wood-ward Hoffmann rules, electocyclic reactions, cyclo-addition reactions (2,2 and 4,2) and sigmatropic shift (1,3,3,3 and 1,5) FMO approach.

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Syllabus

Class - B.Sc. II Year

Subject - Chemistry

Paper - Practical

Max. Marks : 50 **Time: 6 Hours**

Inorganic Chemistry **12 Marks**

(i) Analysis of inorganic mixture containing five radicals with at least one interfering radical.

(ii) Determination of acetic acid in commercial vinegar using NaOH

(iii) Redox titrations.

(iv) Estimation of hardness of water by EDTA.

(v) To determine the concentration of HCl with NaOH using potentiometer.

Physical Chemistry **12 Marks**

(i) Determination of transition temperature of given substance by thermometric method.

(ii) To determine the enthalpy of neutralization of strong acid, strong base.

(iii) Verification of Beer's- Lambert law.

(iv) To study the phase diagram of two component system by cooling curve method.

Organic Chemistry (Any two) **12 Marks**

(i) Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

(ii) Use of Paper chromatography /Thin layer chromatography: determination of Rf values, separation and identification of organic compounds.

a. Separation of green leaf pigments (spinach leave may be used)

b. Separation of dyes.

Viva-voce **6 Marks**

Record **8 Marks**

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Syllabus

Class - B.Sc. III Year

Subject - Chemistry

Paper - Practical

Max. Marks : 50 **Time: 6 Hours**

Inorganic Chemistry **12 Marks**

(i) Gravimetric analysis:
Barium as Barium sulphate, Copper as cuprous-thiocynate.

(ii) Complex compound preparation
   a. Potassium chlorochromate (IV)
   b. Tetramine copper (II) sulphate monohydrate
   c. Hexamminenickel (II) chloride

(iii) Effluent water analysis, Identification of cations and anions in different samples.

(iv) Water analysis, To determine dissolved oxygen in water samples in ppm.

Physical Chemistry **12 Marks**

(i) To determine the velocity constant (specific reaction rate) of hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.

(ii) Determination of partition coefficient of iodine between carbon tetra chloride and water.

(iii) Job's method.

(iv) pH-metric titrations, conductometric titrations.

Organic Chemistry **12 Marks**

1. Binary mixture analysis containing two solids:
   Separation,identification and preparation of derivatives.
2. Preparation.
   (i) Acetylation, (ii) Benzolylation (iii) Meta dinitro benzene
   (iv) Picric acid, p-nitro acetanilide, Dibenzyleacetone

Viva-voce **6 Marks**

Record **8 Marks**