UNIV. DEPTT. OF CHEMISTRY

KOLHAN UNIVERSITY, CHAIBASA

UNDERGRADUATE PROGRAMME

CBCS Syllabus Of B.Sc.

Chemistry Honours

(Semester System)

CONTENTS

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – I

Core Course : 1

Inorganic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. Atomic Structure : 08 Hrs.

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, schrodinger's wave equation, significance of Ψ and Ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule of multiplicity, Electronic configuration of the elements, effective nuclear charge.

2. Periodic Properties : 10 Hrs.

Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination or evaluation in periodic table and applications in predicting and explaining the chemical behaviour.

3. Chemical Bonding : 10 Hrs.

(a) Covalent bon-valence bond theory and its limitation, directional characteristics of covalent bond, various types of hybridization and hapes of simple inorganic molecules and ions. Valence shall electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_6, ClF_3, ICl and H_2O. MO theory homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

(b) Ionic Solids – Ionic structures, radius ratio rule and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule Metallic bond-free electron, valence bond and band theories.

(c) Weak interactions – Hydrogen bonding, van-der Waals' forces.

4. s-Block Elements : 05 Hrs.

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

5. p-Block Elements : 08 Hrs.

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides oxides, oxyacids and halides of groups 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerences, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

6. Chemistry of Noble Gases : 06 Hrs.

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Books Recommended

Inorganic Chemistry

1. Pradeep's Inorganic Chemistry, Vol.- I, II and III
2. Dinesh Inorganic Chemistry, Vol.- I, II and III
3. Text Book of Inorganic Chemistry by P.L. Soni
4. Selected Topics in Inorganic by Satyaprakash, Malik, Madan and Tuli
5. Advanced Inorganic Chemistry by Gurdeep and Harish
6. Advanced Inorganic Chemistry by Cotton and Wilkinsons
7. Principles of Inorganic Chemistry by Puri, Sharma and Kalia
8. Inorganic Chemistry, by Moillers

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – I

Core Course : 2

Physical Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Mathematical Concepts :** 08 Hrs.

   Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like e^x, x^n, sinx, tanx & $\log e^x$; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions : permutations and combinations, Factorials. Probability.

2. **Gaseous States :** 10 Hrs.

   Postulates of kinetic theory of gases, deviation from ideal behaviour, van-der Waals' equation of state. Critical phenomena : PV isotherms of real gases, continuity of states, the isotherms of van-der Waals' equation, relationship between critical constants and van-der Waals' constant, the law of corresponding states, reduced equation of state. Molecular velocities : Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule-Thomson effect).

3. **Liquid State :** 06 Hrs.

   Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals : difference between liquid crystal, solid and liquid. Classification, structures of nematic, smectic and cholesteric phases. Thermography and seven segment cell.

4. **Solid State :** 08 Hrs.

   Definition of space lattice, unit cell.

   Laws of crystallography –

   (i) Law of constancy of interfacial angles

   (ii) Law of rationality of indices

   (iii) Law of symmetry, symmetry elements in crystals.

   X-ray diffraction by crystals. Derivation of Bragg equation.

   Determination of crystal structure of NaCl, KCl, and CsCl (Laue's method and powder method).

5. Colloidal State : 08 Hrs.

Definition of colloids, classification of colloids, solids in liquids (sols) : Properties-kinetic, optical and electrical, stability of colloids, protective action Hardy-Schulze law, gold number. Liquids in liquids (emulsion) : types of emulsions, preparation. Emulsifier, liquid in solids (gels) : classification, preparation and properties, inhibition, general applications of colloids.

Books Recommended

Physical Chemistry

1. Pradeep's Physical Chemistry, Vol.-I, II and III
2. Dinesh Physical Chemistry, Vol.-I, II and III
3. Text Book of Physical Chemistry by Puri Sharma and Pathania
4. Advanced Physical Chemistry by D.N. Bajpai
5. UGC Advanced Physical Chemistry by J.N. Gurtu and A. Gurtu, Vol.-I, II and III
6. Physical Chemistry by P.C. Rakshit
7. Advanced Physical Chemistry by Gurdeep Raj
8. Physical Chemistry, by Atkins
9. A text book of Physical Chemistry, by Glasstone

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – I

Core Course (P) : 1

Inorganic Chemistry (Practical)

Full Marks – 60 **Time : 04 Hours**

1. **Qualitative analysis of inorganic salts mixture containing two basic and two acid radicals with no interfering radical from the following :**

   Pb^{2+}, Bi^{3+}, Sn^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Co^{2+}, Zn^{2+}, Mn^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Na^{+} , K^{+}, Mg^{2+} and NH_4^{+}

   Acid radicals : CO_3^{2-}, SO_4^{2-}, S^{2-}, NO_3^{-} and halides.

2. Volumetric analysis :-

   Estimation in a

   (a) Mixture of NaOH and Na_2CO_3

   (b) Mixture of $NaHCO_3$ and Na_2CO_3

3. Determination of Ferrous iron using standard KM_nO_4 solution.

Two experiments :

Qualitative

BR – 8+8 + AR-(4+4) = 24

Volumetric = 16 Marks

NB and Regularity = 10 Marks

Viva-voce = 10 Marks

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – II

Core Course : 3

Organic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. Classification and nomenclature of organic compounds. Detection and estimation of elements, (N,S,P and halogens). Determination of molecular weight of organic acids and organic bases. 06 Hrs.

2. Structure and Bonding : 08 Hrs.

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals' interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyper conjugation aromaticity, inductive and field effects, hydrogen bonding.

3. Mechanism of Organic Reactions : 12 Hrs.

Curved arrow notation drawing electron movements with arrows, half-headed and double-headed arrow, hemolytic and heterolytic bond breaking. Types of reagents, electrophiles and nucleophiles. Types of organic reactions Energy considerations. Reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on itermediates and other ionic species. Methods of determination of reaction mechanism (product analysis intermediates, isotopic effects, kinetic and stereochemistry studies).

4. Stereochemistry of Organic Compounds : 10 Hrs.

Concept of isomerism. Types of isomerism. Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism-determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerismin oximes and alicyclic compounds. Conformational isomerism-conformational analysis of ethane and n-bu-tane; conformations of cyclohexane, axial and equatorial bonds. Conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

5. Alkanes and Cycloalkanes : 08 Hrs.

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in kanes, Isomerilm in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes : orientation, reactivity and selectivity. Cycloalkanes-nomenclauture, methods of formation, chemical reaction's Baeyer's strain theory and its limitations. Ring strain in smalt rings (cyclopropane and cyclobutane) theory of strainless rings. The case of cyclopropanering : banana bonds.

6. Alkenes, Cycloalkenes, Dienes and Alkynes : 16 Hrs.

Nomenclature of alkenes, method of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hotmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanism involved in hydrogenation, Electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxiation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxytation and oxidation with $KMnO_4$, Polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature and classification of dienes : isolated conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, Polymerization. Chemical reaction-1, 2 and 1, 4 additions. Diels-Alder reaction. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reations of alkynes. Acidity of alkynes, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

Books Recommended

Organic Chemistry

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2. Pradeep's Organic Chemistry by Pradeep Publication
3. Dinesh Organic Chemistry
4. Text Book of Organic Chemistry, Vol.- I and II by I.L. Finar
5. Text Book of Organic Chemistry, Vol.- I and II by P.L. Soni
6. Reactions and Reagents by O.P. Agarwal
7. Reactions and Reagents by Gurdeep Raj Chatwal.
8. Organic Chemistry by Morrison and Boyd

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – II

Core Course : 4

Physical Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Chemical kinetics :** 10 Hrs.

   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, pseudo 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. Radioactive decay as a first order phenomenon. Experimental method of chemical kinetics : conductometric, potentiometric, optical methods, polarimetry and spectrophotometer. 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 (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

2. **Catalysis :** 05 Hrs

   Type of catalyst and catalysis, Homogeneous and heterogeneous catalysis, enzyme catalysis, Theory of catalysis, characteristics of catalysed reactions, action of catalytic promoters and in hibitors, miscellaneous examples.

3. **Chemical Equilibrium :** 05 Hrs.

   Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction Isochore-Clapeyron equation and Clausius-Clapeyron equation, applications.

4. **Surface Chemistry :** 08 Hrs.

   Difference between absorption and adsorption. Adsorbate and adsorbent, types of adsorption, elementary idea and Gibb's adsorption equation, free energy, isotherms, Fruendlich and Langmuir' adsorption isotherms, qualitative treatment of BET isotherm and its application to surface area measurement, application of adsorption.

5. Phase Equilibrium : 12 Hrs.

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems. Phase equilibria of two component system-solid-liquid equilibria, simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H_2O) $FeCl_3$-H_2O and $CUSO_4$-H_2O system. Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes – HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethyl amine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on con-solute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications.

Books Recommended

Physical Chemistry

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5. UGC Advanced Physical Chemistry by J.N. Gurtu and A. Gurtu, Vol.-I, II and III
6. Physical Chemistry by P.C. Rakshit
7. Advanced Physical Chemistry by Gurdeep Raj
8. Physical Chemistry, by Atkins
9. A Text Book of Physical Chemistry, by Glasstone

Chemistry

B.Sc. (Hons.)

Semester – II

Core Course (P) : 2

Physical Chemistry (Practical)

Full Marks – 60 **Time : 04 Hours**

1. Determination of surface tension of liquids by stalagmometer.
2. Determination of Co-efficient of viscosity using ostwald's viscometer.
3. Determination of rate constant for the bydrolysis of ester catalyzed by hydrogen ion at room temperature.
4. Study of the effect of concentration on surface tension of acetic acid and sodium chloride solutions.
5. Determination of percentage composition of a mixture of two liquids by viscosity measurement.

Experiment = 40 Marks

Notebook and Regularity = 10 Marks

Viva-voce = 10 Marks

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – III

Core Course : 5

Inorganic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Oxidation and reduction :** 8 Hrs.
   Use of redox potential data-analysis of redox cycle, redox stability in water-frost, Latimer and Pourbaix diagrams, Principles involved in the extraction of the elements.
2. **Acids and Bases :** 06 Hrs.
   Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent systems and Lewis concepts of acids and bases. Relative strength of acids, trends in acid strength, strength of oxo-acid.
3. **Non-aqueous Solvents :** 06 Hrs.
   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.
4. **Chemistry of Elements of First Transition Series :** 10 Hrs.
   Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.
5. **Chemistry of Elements of Second and Third Transition Series :** 10 Hrs.
   General characteristics, comparative treatment with respect to ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.
6. **Metal-ligand Bonding in Transition Metal Complexes :** 10 Hrs.
   Limitations of valence bond theory and elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

Books Recommended

Inorganic Chemistry

1. Pradeep's Inorganic Chemistry, Vol.- I, II and III
2. Dinesh Inorganic Chemistry, Vol.- I, II and III
3. Text Book of Inorganic Chemistry by P.L. Soni
4. Selected Topics in Inorganic by Satyaprakash, Malik, Madan and Tuli
5. Advanced Inorganic Chemistry by Gurdeep and Harish
6. Advanced Inorganic Chemistry by Cotton and Wilkinsons
7. Principles of Inorganic Chemistry by Puri, Sharma and Kalia
8. Inorganic Chemistry, by Moiller

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – III

Core Course : 6

Organic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. Arenes and Aromaticity : 8 Hrs.

Nomenclature of benzene derivatives. The aryl group Aromatic nucleus and side chain. Structure of benzene : molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure. MO picture.

Aromaticity : the Huckel rule, aromatic ions. Aromatic electrophilic substitution-general pattern of the mechanism, role of σ and π complexes. Hechanism 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 Methods of formation and chemical reactions of alkylbenzenes, alkynyl benzenes and biphenyl.

2. Alkyl and Aryl Halides : 6 Hrs.

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams. Polyhalogen compound : chloroform, carbon tetrachioride, method of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides, vs allyl, vinyl and aryl halides, synthesis and uses of DDT and BHC.

3. Alcohols : 5 Hrs.

Classification and nomenclature.

Monohydric alcohols-nomencalture, method of formation by reduction of aldehydes ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature Reactions of alcohols. Dihydric alcolos-nomenclature, methods of formation chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and $H10_4$] and pinacol-pinacolone rearrangement. Trihydric alcohols-nomenclature and methods of formation, chemical reactions of glycerol.

4. Phenols : 6 Hrs.

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative aciaic strengths of alcohols and phenols, resonance stablilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Machanisms of Fries rearrangement, Ciaisen rearrangement, Gatterman sysnthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

5. Ethers and Epoxides : 5 Hrs.

Nomenclature of ethers and methods of their formation, physical properties Chemical reaction-cleavage and auto-oxidation, Ziesel's method. Synthesis of epoxides. Acid and base-catalyzed ring opening of expoxides, orientation of epoxide ring-opening Reactions of Grignard and organolithium reagents with epoxides.

6. Organic Compounds of Nitrogen : 10 Hrs.

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

Books Recommended

Organic Chemistry

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UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – III

Core Course : 7

Physical Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Thermochemistry :** 08 Hrs.

   Standard state, standard enthalpy of formation-Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization. Bond dissociation energy and its calculation from thermochemical data, temperature dependence of enthalpy. Kirchhoff 's equation.

2. **Thermodynamics 1 :** 10 Hrs.

   Definition of thermodynamic terms : systems, surrounding etc. Types of system, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. First Law of Thermodynamics : Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-Joule-Thomson coefficient and inversion temperature. Calculation of w,q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

3. **Thermodynamics II :** 12 Hrs.

   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 V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium, Entropy change in ideal gases and mixing of gasses. 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 functions (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equailibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

4. **Physical Properties & Molecular Structure I** 10 Hrs.

   Parachor, refractive index & Molecular refractivity, Dipole moment, magnetic properties and Magnetic susceptibility, Additive & Constitutive Properties and their uses in elucidation of molecular structure.

5. Physical Properties & Molecular Structure II 05 Hrs.

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

Books Recommended

Physical Chemistry

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Chemistry

B.Sc. (Hons.)

Semester – III

Core Course (P) : 3

Organic Chemistry (Practical)

Full Marks – 90 **Time : 06 Hours**

1. Detection of element [N, S, P and halogens] and detection of functional group in organic compounds containing one functional group including monosaccharides.
   – COOH, Phenolic – OH, Aldehydic, Ketonic, Nitro, Amino and amides.
2. Organic preparations :
   (i) Aspirin from salicylic acid.
   (ii) P-methylacetanilide from p-toluidine.
   (iii) Acetanilide from aniline.
   (iv) Preparation of Benzanilide from aniline.
   (v) Preparation of Benzoic acid from benzaldehyde.

Two Experiments :

Qualitative = 30 Marks

Preparation = 30 Marks

Notebook and Regularity = 15 Marks

Viva-voce = 15 Marks

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – IV

Core Course : 8

Inorganic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Hard and Soft Acids and Bases (HSAB)** : 07 Hrs.

   Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

2. **Chemistry of Lanthanide Elements :** 8 Hrs.

   Electronic configurations, oxidation states, atomic and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, compounds of lanthanide elements.

3. **Chemistry of Actinides :** 8 Hrs.

   General features and Chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

4. **Co-ordination compounds :** 10 Hrs.

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

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6. Advanced Inorganic Chemistry by Cotton and Wilkinsons
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8. Inorganic Chemistry, by Moiller

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – IV

Core Course : 9

Organic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 20

1. **Aldehydes and Ketones :** 12 Hrs.

   Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties, Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives, Witting reaction. Mannich reaction.

   Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones. Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. An introduction to α, β unsaturated aldehydes and ketones.

2. **Carboxylic Acids :** 08 Hrs.

   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 Vol Hard-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. Hydroxy acids : malic, tartaric and citric acids. Methods of formation and chemical reactions of unsaturated mono-carboxylic acids. Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

3. **Carboxylic Acid Derivatives :** 03 Hrs.

   Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reaction. Mechanisms of esterification and hydrolysis (Acidic and Basic)

4. Spectroscopy u.v. visible I.R : 12 Hrs.

Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert's law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic hyperchromic and hypochromic shifts. UV spectra of conjugatedienes and enones, infrared (IR) absorption spectroscopy-molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

Books Recommended

Organic Chemistry

1. Advanced Organic Chemistry by Bahl and Bahl
2. Pradeep's Organic Chemistry by Pradeep Publication
3. Dinesh Organic Chemistry
4. Text Book of Organic Chemistry, Vol.- I and II by I.L. Finar
5. Text Book of Organic Chemistry, Vol.- I and II by P.L. Soni
6. Reactions and Reagents by O.P. Agarwal
7. Reactions and Reagents by Gurdeep Raj Chatwal.
8. Organic Chemistry by Morrison and Boyd

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – IV

Core Course : 10

Physical Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Electrochemistry I :** 12 Hrs.

   Electrical transport-conduction in metals and in electrolyte solution, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

   Migration of ions and Kohlrausch law, Arrhenius theory of electrolytic dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitation. 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 Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

2. **Electrochemistry II :** 10 Hrs.

   Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reaction. 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 of cell reactions (ΔG, ΔH and K), polarization, over potential and hydrogen overvoltage. Concentration cell with and without transport, liquid junction potential, application of concentration cell, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers-mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salts, Corrosin-types, theories and methods of combating it.

3. Solutions, Dilute Solutions and Colligative Properties : 07 Hrs.

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

Books Recommended

Physical Chemistry

1. Pradeep's Physical Chemistry, Vol.-I, II and III
2. Dinesh Physical Chemistry, Vol.-I, II and III
3. Text Book of Physical Chemistry by Puri Sharma and Pathania
4. Advanced Physical Chemistry by D.N. Bajpai
5. UGC Advanced Physical Chemistry by J.N. Gurtu and A. Gurtu, Vol.-I, II and III
6. Physical Chemistry by P.C. Rakshit
7. Advanced Physical Chemistry by Gurdeep Raj
8. Physical Chemistry, by Atkins
9. A text book of Physical Chemistry, by Glasstone

Chemistry

B.Sc. (Hons.)

Semester – IV

Core Course (P) : 4

Inorganic Chemistry (Practical)

Full Marks – 90 **Time : 06 Hours**

1. Qualitative analysis of mixtures of inorganic salts containing six radicals including one interfering radical from among those given below :

Basic radicals : Ag^{+}, Pb^{2+}, Bi^{3+}, Sb^{2+}, Sn^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Co^{2+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Na^{+}, K^{+}, Mg^{2+}, NH_4^{+}

Acid radicals : Acetate, Borate, Oxalate, Phosphate, CO_3^{2-}, SO_4^{2-}, S^{2-}, NO_3^{-}, halides.

2. (a) Determination of Ferrous iron using standard $K_2Cr_2O_7$ solution.

(b) Estimation of copper in the given solution using standard sodium thiosulphate solution.

Two Experiments :

Qualitative – 40

BR – 8 + 8 + 8 Marks

AR – 4 + 4 + 8 Marks (Interfering)

Volumetric – 20 Marks

Notebook and Regularity – 15 Marks

Viva-voce – 15 Marks

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – V

Core Course : 11

Organic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Spectroscopy :** 10 Hrs.

   Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (1HNMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure; spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1-2 tribromoethane, ethyl acetate, toluence and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

2. **Organo Sulphur Compounds :** 04 Hrs.

   Nomenclature, structural features, methods of formation and chemical reaction of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

3. **Organic Synthesis via Enolates :** 06 Hrs.

   Acidity of α hydrogens, alkylation of diethyl molanate and ethyl acetoacetate. Synthesis of ethyl acetoacetate : the Claifen condensation. Keto-enol tautomerism of ethyl acetoacetate, Alkylation of 1,3-dithianes, alkylation and acylation of enamines.

4. **Organo metallic Compounds :** 06 Hrs.

   Organomagnesium compounds : the Grignard reagents-formation, structure and chemical reaction. Organozinc compounds : formation and chemical reactions. Organolithium compounds : formation and chemical reactions.

5. **Hetrocyclic Compounds :** 10 Hrs.

   Introduction : Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reaction with particular emphasis on the mechanism of electrophilic substitution.

   Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed, five and six-membered heterocyles. Preparation and

reaction of indole, quinolone and isoquinoline with special reference to Fischer indole, quinoline synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole and isoquinoline.

Books Recommended

Organic Chemistry

1. Advanced Organic Chemistry by Bahl and Bahl
2. Pradeep's Organic Chemistry by Pradeep Publication
3. Dinesh Organic Chemistry
4. Text Book of Organic Chemistry, Vol.- I and II by I.L. Finar
5. Text Book of Organic Chemistry, Vol.- I and II by P.L. Soni
6. Reactions and Reagents by O.P. Agarwal
7. Reactions and Reagents by Gurdeep Raj Chatwal.
8. Organic Chemistry by Morrison and Boyd

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – V

Core Course : 12

Physical Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Photochemistry :** 12 Hrs.

   Interaction of radiation with matter. Difference between photochemical reactions and thermochemical reactions. Laws governing absorption of light : Lambort's law and Beer's law. Molar extinction co-efficient and optical density. Laws of photochemistry : Grothus-Draper law, Stark Einstein law Quantum yield. Low and high quantum yield. Experimental determination of quantum yield of a photochemical reaction. Some photochemical reactions : photolysis of HI, photochemical reactions between H_2 and Br_2 and H_2 and Cl_2. Jablonski diagram depicting various processes occurring in the excited state. Quenching of fluorescence, Qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitization, photosensitized reactions – energy transfer processes (simple examples), photochemical equilibrium.

2. **Nuclear Chemistry :** 07 Hrs.

   Nucleus and nuclear particles Binding energy and nuclear stability, Radioactivity Radioactive, disintegration, Natural & artificial radioactivity, Group displacement law, Radioactive disintegration series, rate of nuclear disintegration, half-life and average life period, Nuclear fission and fusion, radio carbon dating, hazard of radioactive, application of radioactivity.

3. **Elementary quantum mechanics :** 20 Hrs.

   Black-body radiation, Kirchhoff's law, Spectral distribution of 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, Schrodinger wave equation and its importance, wave functions, physical interpretation of the wave function, Hamiltonian operator, postulates of quantum mechanics, Derivation of Schrodinger wave equation on the basis of the postulates of quantum mechanics, particle in a one dimensional box. Schrodinger wave equation

for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave function.

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 anti-bonding wave functions, concepts of $\sigma, \sigma*, \pi, \pi*$ orbitals and their characteristics, 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, comparison of M.O. and V.B. models.

Books Recommended

Physical Chemistry

1. Pradeep's Physical Chemistry, Vol.-I, II and III
2. Dinesh Physical Chemistry, Vol.-I, II and III
3. Text Book of Physical Chemistry by Puri Sharma and Pathania
4. Advanced Physical Chemistry by D.N. Bajpai
5. UGC Advanced Physical Chemistry by J.N. Gurtu and A. Gurtu, Vol.-I, II and III
6. Physical Chemistry by P.C. Rakshit
7. Advanced Physical Chemistry by Gurdeep Raj
8. Physical Chemistry, by Atkins
9. A text book of Physical Chemistry, by Glasstone

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – V

DSE 1

Bio-Inorganic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. Essential and trace elements in biological processes : metals like Fe, Cu, Se, Cr and Mo. Essential and trace non-metals : like P (in the form of Phosphate), Iodine and Chlorine.
2. **Essential Bulk Elements :**

   Na and K, Ca and Mg in the form of Na^+ / K^+ and Ca^{2+} / Mg^{2+}. Biological roles of alkali and alkaline earth metal ions
3. Metalloporphyrins
4. Transport and Storage of Dioxygen : Hemeproteins and oxygen uptake, Haemoglobin and myoglobin functions and co-operativity, structures of haemoglobin and myoglobin. Role of hemoglobin and myoglobin.
5. Oxidation and oxygenation of Hb and Mb.
6. Nitrogenase : Biological Nitrogen fixation.
7. Metals in medicines, Metal deficiency and diseases, Toxic effects of metals.

Book Recommended

Bio-Inorganic Chemistry

1. Bio Inorganic Chemistry by K. Hussain Reddy
2. General Chemistry by R.C. Sarkar
3. Bio Inorganic Chemistry by Kalsi

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – V

DSE 2

Bio-Organic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Enzymes :**

   Introduction and historical perspective Chemical and Biological Catalysis. Nomenelature, classification and extraction of Enzymes, Enzyme inhibition – Reversible and irreversible.

2. **Bio-technological application of enzymes :**

   Use of enzymes in feed and drink industries

3. **Co-enzymes :**

   Structure and biological function of co-enzyme A, co-factors as derived from vitamins, vitamin-B12.

4. **Pharmaceutical Compounds :**

   Structure and Importance, Classification, structure and therapeutic uses of antipyretics, Paracetamol (with synthesis) Analgesic – Ibuprofen (with synthesis).

   Antimalarials : chloroquine (with synthesis), An elementary treatment of Antibiotics and detail study of Chloramphenicol. Medicinal values of curcumin (haldi) azdirachtin (Neem) Vitamin C and anta acid (ranitidine)

Book Recommended

Bio-Organic Chemistry

1. Bio-Organic and Inorganic Chemistry by P.S. Kalsi
2. Introduction to Medical Chemistry- Graham Patrick, Oxford University
3. Medicinal and Pharmaceutical Chemistry, V. K. Kapoor, Vallabh Prakashan

Chemistry

B.Sc. (Hons.)

Semester – V

Core Course (P) : 5

Organic Chemistry (Practical)

Full Marks – 60 **Time : 06 Hours**

1. Identification of monofunctional organic compounds and monosaceharides.
   -COOH, -OH, -CHO, -C=O, Ester, -NO_2, -NH_2, Anilide, Hydrocarbons and unsaturation.
2. Preparation of the following organic compounds.
   (a) Preparation of Picrate derivative from anthracene. .
   (b) P-nitro acetanilide from acetanilide.
   (c) Preparation of semicarbazone derivative from acetophenone.
   (d) Preparation of m-dinitrobenzene from nitrobenzene.

   Two Experiments :
   Detection = 25
   Preparation = 15
   Notebook and Regularity – 10 Marks
   Viva-voce – 10 Marks

Chemistry

B.Sc. (Hons.)

Semester – V

DSE (P) : 1

Physical Chemistry (Practical)

Full Marks – 60 **Time : 04 Hours**

1. Determination of molecular weight of volatile liquid by victor Meyer's method.
2. Determination of Heat of neutralization of
   (a) Strong acid and Strong base.
   (b) Weak acid and Strong base.
3. Determination of partition co-efficient of solute between two immiscible liquids.
   (a) Iodine between carbon tetrachloride and water.
   (b) Benzoic acid between benzene and water.
4. Determination of water equivalent of calorimeter.
5. Determination of refractive index of liquids by Abbe's refractometer and calculation of molecular refractivity of solute.

   Experiment – 40 Marks
   Notebook and Regularity – 10 Marks
   Viva-voce – 10 Marks

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – VI

Core Course - 13

Inorganic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Magnetic Properties of Transition Metal Complexes :** 07 Hrs.

   Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of m_e and m_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

2. **Electronic Spectra of Transition Metal Complexes :** 07 Hrs.

   Type of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectro chemical series. Orgel energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complexion.

3. **Thermodynamic and Kinetic Aspects of Metal Complexes :** 05 Hrs.

   A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

4. **Organometallic Chemistry :** 10 Hrs.

   Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls of Li, Al, Hg, Sn and Ti, a brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

5. **Silicones and Phosphazenes :** 04 Hrs.

   Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

Books Recommended

Inorganic Chemistry

1. Pradeep's Inorganic Chemistry, Vol.- I, II and III
2. Dinesh Inorganic Chemistry, Vol.- I, II and III
3. Text Book of Inorganic Chemistry by P.L. Soni
4. Selected Topics in Inorganic by Satyaprakash, Malik, Madan and Tuli
5. Advanced Inorganic Chemistry by Gurdeep and Harish
6. Advanced Inorganic Chemistry by Cotton and Wilkinsons
7. Principles of Inorganic Chemistry by Puri, Sharma and Kalia
8. Inorganic Chemistry, by Moiller

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – VI

Core Course - 14

Organic Chemistry

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Carbohydrates :** 07 Hrs.

   Classification and nomenclature. Monosacharides, mechanism of osazone formation, interconversion of glucose and fructose, chainlenghtening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+) – glucose, mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

2. **Amino Acids, Peptides, Proteins and Nucleic Acids :** 06 Hrs.

   Classification, structure and stereochemistry of amino acids. Acid base bahaviour, isoelectric point and electrophoresis. Preparation and reaction of amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides Classical peptide synthesis, solidphase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids : introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides, the double helical structure of DNA.

3. **Synthetic Polymers :** 04 Hrs.

   Addition of chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization, polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes – Natural and synthetic rubbers.

4. **Synthetic Dyes :** 08 Hrs.

   Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange. Congo red, Malachitegreen, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

5. Some Important Reagents and their Applications in Organic reactions : 05 Hrs.

Anhydrous aluminium chloride, Boron trifluoride, Lead tetra acetate, Lithium aluminium hydride, Periodic acid, N-Bromo Succinamide (NBS), Sodamide, Sodium Borohydride, Selenium dioxide, Phosphorus penta chloride, Phosphorus pentoxide, Phenyl hydrazine, sodium ethoxide.

Books Recommended

Organic Chemistry

1. Advanced Organic Chemistry by Bahl and Bahl
2. Pradeep's Organic Chemistry by Pradeep Publication
3. Dinesh Organic Chemistry
4. Text Book of Organic Chemistry, Vol.- I and II by I.L. Finar
5. Text Book of Organic Chemistry, Vol.- I and II by P.L. Soni
6. Reactions and Reagents by O.P. Agarwal
7. Reactions and Reagents by Gurdeep Raj Chatwal.
8. Organic Chemistry by Morrison and Boyd

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – VI

DSE 3

Spectroscopy (Physical Chemistry)

Full Marks – 70 **Time : 03 Hours**

Group - A : (Compulsory) 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 2 marks each. 2 x 10 = 20

Group – B : Short answer type questions. Eight questions are to be set out of which 4 are to be answered, carrying 5 marks each. 5 x 4 = 20

Group – C : Long type question : Four questions are to be set out of which two questions are to be answered each question will carry 15 marks. 15 x 2 = 30

1. **Spectroscopy :** 07 Hrs.

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

   Rotational Spectrum: Diatomic moleculars. 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.

   Vibrational Spectrum : 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.

   Raman Spectrum :

   Introduction : Concepts of Polarizability, quantum theory of Raman effect. Theory of Raman spectra (stokes and antistoke's lines). Instrumentation, condition for Raman spectroscopy, equivalence of Beer, Lambert law of absorption of Raman scattering, characteristics Parameters of Raman lines, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rule. Comparison between IR and Raman spectra, applications.

   Electronic Spectrum : Concept of potential energy curves for bonding and anti-bonding 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 transitions.

2. **Nuclear magnetic resonance spectroscopy :**

   Principle of Nuclear Magnetic resonance. NMR technique, Interpretation of the NMR spectra (NMR spectra and Molecular structure) chemical shift. Shielding and Desheilding of protons, Nuclear spin interactions. Applications of NMR spectra.

Books Recommended

Spectroscopy

1. Atomic and molecular Spectroscopy by M. Gupta
2. Organic Spectroscopy by R.L. Sharma
3. Group Theory and symmetry in Chemistry by B.K. Sharma
4. Spectroscopy by Gurdeep Raj

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – VI

Core Course (P) : 6

Inorganic Chemistry (Practical)

Full Marks – 60 **Time : 06 Hours**

1. Gravimetric estimation of Ag^{+}, Ni^{2+}, Cl^{-}, SO_4^{2-}.
2. (a) preparation of sodium nitropruside.
   (b) Preparation of Patsh Alum
   (c) Preparation of chrome alum.
3. Determination of zinc per litre in the given solution using standard EDTA solution.

Gravimetric – 20 Marks
Preparation or Estimation = 20 Marks
Notebook and Regularity – 10 Marks
Viva-voce – 10 Marks

Chemistry

B.Sc. (Hons.)

Semester – VI

DSE (P) : 2

Organic Chemistry (Practical)

Full Marks – 30 **Time : 04 Hours**

1. Preparation of Methyl orange.
2. Determination of molecular weight of organic acid by silver salt method.
3. Determination of food adulterants in the given food items.
4. Determination of the percent purity of glucose.

Experiment – 15 Marks
Notebook and Regularity – 10 Marks
Viva-voce – 05 Marks

UNDERGRADUATE PROGRAMME

Chemistry

B.Sc. (Hons.)

Semester – VI

DSE 4

Project Work (End Sem.)

Time : 06 Hours

(Written component = 100 Marks)
(Written component = 80 + Viva- 20)
Credit = 6

The paper will consist of

(a) Field work / Lab work related to the project.
(b) Preparation of dissertation based on the work undertaken.
(c) Presentation of project work in the seminar on the assigned topic in the Department of Chemistry.

NB : The students will select topics for the project work in consultation with a teacher of the Department.

TOPICS

Project work related to the following Industrial / Socially relevant topics may be given to the students.

(a) Environmental study such as (i) Analysis of Water, Soil, etc.
(b) Industrial goods analysis such as :
    (i) Analysis of Cement.
    (ii) Analysis of Haematite.
    (i) Analysis of minerals available in Jharkhand State.
    (ii) Synthesis of useful commercial products based on raw materials available in Jharkhand State such as Limestone etc.

Each student has to submit the dissertation work duly signed by HOD of the Department.